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Cost of Public Services in Residential Areas

BY

F. DODD McHUGH, ESQ.

WITH DISCUSSION BY

MESSRS. DONALD M. BAKER, HOWARD WHIPPLE GREEN, T. T. McCROSKY, AND F. DODD McHUGH.

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By F. Dodd McHugh,[1] Esq.

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The Problem

Material available, although not conclusive, shows that the United States is faced with a slowing up in the rate of growth. The greatest intensity of this change is felt in cities. During the decade 1910–1920 the population of New York, N. Y., increased 17.8% and that of the nation 14.9%. The increase was 23.3% for the city and 6.1% for the nation during the period 1920–1930. The U. S. Census Bureau reports an increase (in 1940) of only 6.5% for New York City and an increase of 7% for the continental United States since 1930.

Modern trends reveal a shifting of people from the older sections of the city to newer residential developments; but the older sections are only partly vacated and are rarely reoccupied by an influx of people or by new commercial activities. The preliminary report of the Census Bureau shows that Manhattan's population remained practically unchanged between 1930 and 1940, whereas the population of the four other boroughs of New York City increased from 4% to 20%. It now appears that, since the 1934 Real Property Inventory of New York City, some of the older sections of Manhattan have continued to lose population. The new developments in the northern part of the borough have apparently attracted a sufficient number of residents to offset the loss in older sections. The exact extent of this population shift cannot be determined until detailed information by census tracts for 1940 has been analyzed.

In 1934 the Real Property Inventory revealed that about 12% of all dwelling units in New York City were vacant, but that about 5% of Manhattan's dwellings were unoccupied. This inventory also shows that only four fifths of the dwelling units were occupied in the older apartment sections

Note.—Published in June, 1941, *Proceedings*.

[1] Director of Planning, Dept. of City Planning, New York, N. Y.

of Manhattan covered by this study. The Census Bureau's tentative report shows that 7.6% of all dwelling units were vacant in New York City as of April, 1940, and that about 11% were unoccupied in Manhattan. The census shows a gain in the occupancy ratio for the entire city as compared with 1934, but a decline for Manhattan. The meager data now at hand do not suggest that the older apartment districts of this borough have made any considerable gains in population subsequent to 1934. In fact, the preliminary census figures along with building permit, foreclosure, tax delinquent, and rental reports indicate that since 1934 the occupancy of dwellings in the older districts of Manhattan has probably not improved in relation to the city-wide occupancy ratio. Lacking any definite information to the contrary, it may be expected, therefore, that people are still leaving these older apartment districts to live in newer developments.

Why do people move from the older sections of cities? One explanation, given by Clarence A. Perry,[2] is applicable to practically all of the residential sections of New York City and other cities:

> "A prominent New York real estate man recently expressed the opinion that the 'normal life expectancy' of an ordinary dwelling was two or three times that of its neighborhood. In other words, the quality or desirability of a particular district tends to decline long before its component houses begin to wear out. Even so, this observation acquires a general significance only if it is discovered that the neighborhood deterioration affects the value of its individual houses. When the owner of a dwelling finds he can keep it occupied only by progressively lowering its rent, then its actual value is declining and the matter is of importance to the public, since that property is no longer able to bear its original share of the tax burden.
>
> "If this view is correct then the unsatisfactory conditions that lead families to give up their domiciles and move to new quarters become of private and public concern. If the dissatisfaction has arisen from something in the environment, it should be of special interest to the community because the matter is then beyond the power of the individual to correct and must receive attention from the public. That neighborhood conditions do cause people to move is a common view, but there is no unanimity as to just what these conditions are."

When old sections lose population, public services in these sections must be maintained and are usually operated below actual capacity. Meanwhile, additional public services must be supplied to the newer residential developments that are drawing population from the older sections of the city.

A survey made for the (New York City) Department of City Planning shows that one third of the city's gross area was vacant and unimproved in 1938. The 1940 federal census reports that in most of the larger cities of the United States, as well as in New York City, the rate of growth is slowing down. It is apparent from these facts and other considerations that the city has more than enough land available to house its present residential population and commercial activities, as well as any increase to be reasonably expected in the future. This outlook does not evidence a positive need to continue the extension of the

[2] "Housing for the Machine Age," by Clarence A. Perry, Russell Sage Foundation, New York, N. Y., 1939, p. 15.

city's physical growth to outlying undeveloped sections. The present economic and social conditions found in New York City obviously exist in many other cities. The prevalence of such unstable conditions would seem to require careful re-examination of the urban structure with particular reference to the possibilities of revitalizing the older sections of American cities.

Constitutional and statutory provisions usually limit the debt-incurring and real-estate taxing powers of municipalities to a fixed percentage of the assessed valuation of real estate. In general, assessed values are not rising, and the increase of urban government income from all sources, including real-estate taxes, has failed to keep pace with the growing demand for expansion of public services. Consequently the cities' financial capacity to meet changing urban conditions is threatened seriously.

Some of the conditions underlying this study are peculiar to New York City. To the extent that such factors as high density of buildings and population reflect New York characteristics, the findings are not directly applicable to other municipalities. It seems, however, that the methods employed may be useful in measuring the magnitude of a problem that is common to most American cities, and that any differences between one city and another as may be revealed by similar studies will be mainly a matter of degree.

Purpose of Study

An attempt is made in this paper to examine the problem in terms of city expenditures for permanent improvements and public services in old and new residential areas. Two types of residential areas are investigated: (1) A specimen community that is typical of the centrally located, existing residential development; and (2) a newer type of "neighborhood unit" development that is applicable to the rebuilding of old sections or in developing outlying vacant areas.

Costs are estimated for the public services found in the specimen community that represents existing conditions and for replacing the obsolete part of existing public facilities in this old area. The study also explores the public costs involved in rebuilding the old area on a neighborhood unit pattern, and in an identical new development to house the same population on raw land.

The sums that the private developer must spend for land and construction and carrying charges are not considered. Extensive studies by Messrs. Thomas Adams, M. Am. Soc. C. E., and the late Robert Whitten,[3] and Clarence Perry,[4] the President's Conference on Home Building and House Ownership,[5] the National Resources Committee, and others,[6] have approached the problem from planning and housing viewpoints with particular reference to the charges borne by the individual home owner and tenant.

[3] "Neighborhoods of Small Homes," by Robert Whitten and Thomas Adams, Harvard Univ. Press, 1931; and "Design of Residential Areas," by Thomas Adams, Harvard Univ. Press, 1934.

[4] "Housing for the Machine Age," by Clarence Arthur Perry, Russell Sage Foundation, New York, N. Y., 1939; and "Neighborhood and Community Planning," Regional Survey, Vol. VII, Regional Plan of New York and Its Environs, 1929.

[5] "Planning for Residential Districts," Vol. I, and "Slums, Large-Scale Housing and Decentralization," Vol. III, the President's Conference on Home Building and Home Ownership, Washington, D. C., 1932.

[6] "Land, Materials and Labor Costs," *Housing Monograph Series, No. 3*, National Resources Planning Board, Washington, D. C., 1939; see also "Rehousing Urban America," by Henry Wright, Columbia Univ. Press, 1935.

Procedure

A study of this nature is necessarily developed from, and limited by, hypotheses that may not be accepted in their entirety. It is believed, however, that the principles underlying this study furnish a sound approach to a complex problem.

The procedures used in this study involve the selection of the types and geographic location of specimen residential communities; the determination of land uses and building bulk in a specimen community representing old sections, and the allocation of land uses and fixing of building bulk in the "neighborhood units" as the basis for estimating the population that can be accommodated in each type of specimen community; the determination of the character and extent of public services existing in old sections and the needs for public services required to serve the residents of neighborhood units; and estimating the costs to the city for permanent improvements and annual operating expenses in each community.

Character of Development

The several community studies undertaken by the Mayor's Committee on City Planning prior to 1938 supply the most recent information on the character of development existing in the fully developed, high-density apartment districts located in the old central parts of the city. It should be noted that these communities are predominantly residential districts. In addition to dwellings, they have parks, schools, churches, local business, and other community facilities that serve residential needs. There are, however, cemeteries and industries in some of these communities that are not considered desirable within residential districts.

Existing Multi-Family Areas.—The Mayor's Committee Studies designated as East Harlem, East Side, and Yorkville are typical of existing conditions in the older apartment districts of Manhattan. Of their aggregate land area, 35.55% is used for streets on the gridiron system; only 2.7% is not built upon; 3.6% is parks; about 38.5% is residential; and the remainder is made up of business, industry, public buildings, and private institutions (see Table 1).[7] About 95% of the population lives in apartments and more than 87% of the residential land is used for multi-family housing.

The population was reported as 678,446 by the 1934 Real Property Inventory, but the total available family quarters were only 79.6% occupied. With full occupancy of all family quarters, 851,900 persons could be accommodated in the housing existing in these communities in 1934. The land areas expressed as acres per 1,000 persons in Table 1 are based on this estimate of "population provided for in existing housing."

If all apartments were occupied, the 851,900 persons housed on the 1,254.4 residential acres would produce a density of 678 persons per net acre! Allowing 70% coverage of residential land and 242 sq ft of building area per person, apartments would average 5.3 stories in height to house this population. As a rough check on this value for average height, it is only necessary to inspect

[7] Data from East Harlem, East Side, and Yorkville Community Studies of the Mayor's Committee on City Planning (1935).

these communities. One finds that most of the buildings are old "walk-up" flats or brownstone houses converted into apartments. Relatively few "new law" multi-family buildings of more than six stories will be seen and most of them are found on main thoroughfares. In Yorkville, for example, such apart-

TABLE 1.—"Built-Up Experience" in Central Apartment Communities of New York City

Land Use	Area		Percentage of:	
	In acres	In acres per 1,000 persons	Gross area	Developed area
Developed Area:				
(a) Net Usable—				
Residential	1,254.4	1.47	38.49	39.56
Business	276.8	0.32	8.50	8.73
Industry	149.8	0.17	4.60	4.72
Institutions	209.4	0.28	6.42	6.61
Parks and Playgrounds	119.9	0.14	3.67	3.78
Cemeteries	1.5	.....	0.04	0.05
Total net area	2,011.8	2.36	61.72	63.45
(b) Streets in use	1,158.8	1.36	35.55	36.55
Total developed	3,170.6	3.72	97.27	100.00
Vacant land	89.1	0.10	2.73	.....
Gross area	3,259.7	3.82	100.00	.....

ments are situated along the north-and-south avenues and the major east-and-west streets.

The 1934 Real Property Inventory shows that about 85% of the buildings in East Harlem were erected prior to 1900, and further, that about 14% of these structures are between twenty and thirty-five years old. More than one fifth of the residential buildings need major repairs and two thirds require minor repairs; only 9% are in first-class condition. The 1935 survey of the Mayor's Committee on City Planning discloses that (1) nearly 23% of the properties in East Harlem were tax delinquent, and (2) that of a total assessed valuation of $263,000,000, land accounted for $125,000,000 or 47% of the total.

New Residential Units.—The diverse and sporadic development of individual properties under built-up experience usually produces the situation reflected in the foregoing examination of existing multi-family areas.

It is believed that urban blight may be combated successfully through large-scale planning and development, both in older, central, deteriorated districts and in new outlying districts. If such large-scale developments are not to become obsolete faster than the individual buildings therein, they must be of a size sufficient to permit the establishment of a self-contained neighborhood that can create a desirable residential environment and can maintain this character by preventing the occurrence of conditions that have caused people to move away from existing residential communities, leaving vacant dwellings and partly used public improvements that must be duplicated elsewhere. These new neighborhoods must also offer the amenities for urban living that will enable them to compete successfully with the newer developments that attract people from older sections of the city to suburban districts.

The Neighborhood Unit.—It is not the purpose of this study to formulate means nor to evaluate procedures suggested by others to promote the development of the newer type of residential neighborhood. Mr. Perry has presented [2] possible approaches to the problems inherent in development of neighborhoods. The neighborhood unit concept, as presented by Mr. Perry, sets the pattern for self-contained communities, and was adopted with minor modifications as the basis for ascertaining the costs of public improvements and services in newer types of residential developments. "The neighborhood unit—a scheme for arrangement for the family-life community" consists of six principles:[3]

(1) *Size.*—A neighborhood unit should provide housing for that population for which one elementary school is ordinarily required, its actual area depending upon its population density.

(2) *Boundaries.*—The unit should be bounded on all sides by arterial streets, sufficiently wide to facilitate its by-passing, instead of penetration, by through traffic.

(3) *Open Spaces.*—A system of small parks and recreation spaces, planned to meet the needs of the particular neighborhood, should be provided.

(4) *Institution Sites.*—Sites for the school and other institutions having service spheres coinciding with the limits of the unit should be suitably grouped about a central point.

(5) *Local Shops.*—One or more shopping districts, adequate for the population to be served, should be laid out in the circumference of the unit, preferably at traffic junctions and adjacent to similar districts of adjoining neighborhoods.

(6) *Internal Street System.*—The unit should be provided with a special street system, each highway being proportioned to its probable traffic load, and the street net as a whole being designed to facilitate circulation within the unit and to discourage its use by through traffic.

In addition to the foregoing principles the neighborhood unit formula as used in this study implies that: (1) Building density should be limited to insure light and air to residents and to prevent unnecessary overcrowding of the land; (2) the unit should be fully developed in order to utilize land, buildings, and public services efficiently; and (3) public and private facilities should be adequate to meet the needs of the people living in such self-contained residential neighborhoods. These principles of the unit scheme can ordinarily be fully applied to new developments only. Consequently, the neighborhood unit principle may be limited to outlying unbuilt areas and to the rebuilding of centrally located deteriorated districts.

Types of Development Studied

This neighborhood unit formula seems to present a sound technique for the development of communities that will avoid the incipient blight and early deterioration experienced in existing residential sections. If this new type of development can establish and maintain a desirable environment for residential

[3] "Neighborhood and Community Planning," Regional Survey, Vol. VII, Regional Plan of New York and Its Environs, 1929.

neighborhoods, stabilize development, and conserve values by helping to prevent unnecessary shifting of population, then the relative costs of public improvements in such neighborhoods are of considerable interest. This paper, therefore, undertakes to examine two types of development—(1) an area characteristic of existing development, and (2) a new neighborhood unit that could be used in rebuilding the old area or for a new development on vacant land.

Existing Area Selected for Study.—The character and extent of development in specimen Area *A*, Fig. 1, is determined by the "built-up experience" exhibited in the three multi-family communities surveyed by the Mayor's Committee on City Planning. (The locations shown in Fig. 1 are not intended to

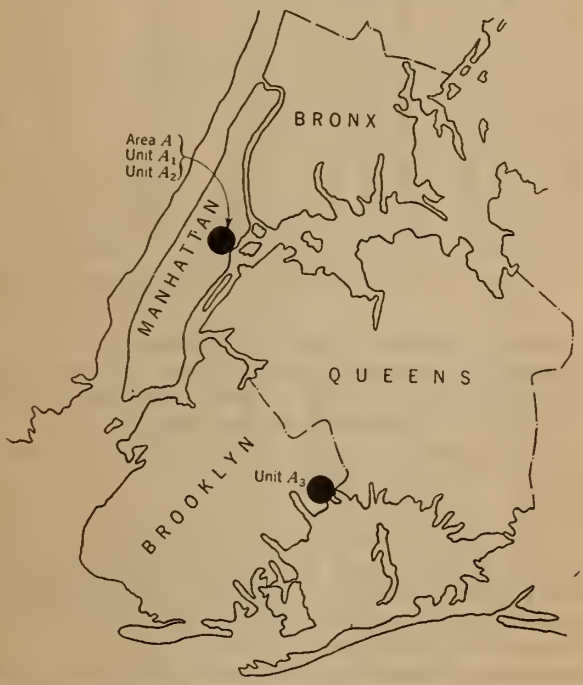

Fig. 1.—Approximate Location of the 160-Acre Communities, New York, N. Y.

designate specific areas but merely to show the approximate locations.) Area *A* is a fully developed apartment district situated in the central city; it is typical of the "built-up experience" in existing multi-family areas that are developed on a gridiron street plan. Such areas are usually found in the older sections of most large cities.

New Units Selected for Study.—Each of the neighborhood unit types of development selected for study is predicated upon the principles underlying the unit formula and upon the following minimum "standards":

Unit A_1.—This development represents an attempt to apply the neighborhood unit scheme in the rebuilding of Area A on a super block plan, which involves the conversion of the "normal" street system shown in Fig. 2 to the master block plan in Fig. 3. It provides sufficient new apartments to rehouse the present population of Area A, and the necessary private facilities and public services required to serve this population.

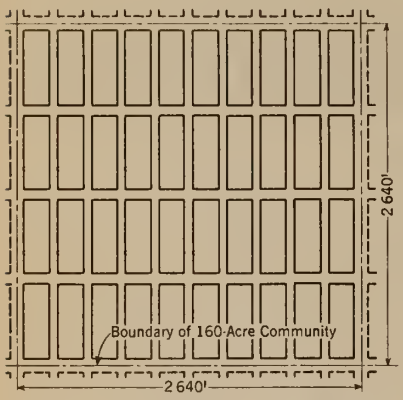

Fig. 2.—"Normal" Gridiron Street Systems (Area A)

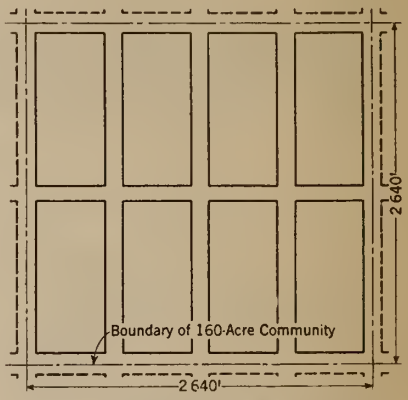

Fig. 3.—Master Block Street Systems (Units A_1 and A_2)

If the present population of Area A is rehoused on the same site, under minimum standards for attendant facilities, there would be 15.11 acres less land available for dwellings in Unit A_1 than is now used for apartments in Area A (see Table 2). Consequently, the building bulk of the new apartments in Unit A_1 would exceed the bulk of buildings existing in old Area A. At an average height of six stories, apartments in Unit A_1 must cover 68% of the residential land.

Unit A_2.—This development also applies the neighborhood unit formula in the rebuilding of Area A on a master block plan. In Unit A_2, however, apartments averaging six stories cover only 50% of the residential land. The new buildings in Unit A_2 would have less bulk than the apartments and would, therefore, house fewer people than live in Area A.

It is believed that the building bulk resulting from 68% cover, six story apartments, which is required in Unit A_1 to rehouse the present population of Area A on the same site, would make that new unit an obsolete development. The apartments in Unit A_2, covering only 50% of the residential land and averaging six stories in height, provide more open space and permit a better layout which would probably be subject to a much lower rate of obsolescence than the bulkier buildings of Unit A_1.

Unit A_3.—Unit A_3 is a new apartment development on raw land; it is identical to Unit A_2 and houses the same population; but entirely new public facilities are needed in the undeveloped outlying section selected as a site for Unit A_3. This development is predicated on six-story buildings covering 50%

of the residential land. Such a building bulk is not desirable in outlying districts; nor should it be implied that this study so recommends. The purpose of this theoretical development, the same as the other units, is to afford a direct comparison of the results obtained.

Land Area of Speciman Communities.—The specimen area and units studied are considered predominantly residential in character with only such local business, recreational, and cultural facilities within their boundaries as are required for the convenient service of the persons housed in each community.

TABLE 2.—Land Use Allocation on Each 160 Acres in Residential Neighborhoods

Description	Area A	Unit A_1	Unit A_2	Unit A_3
(*a*) General Data and Population				
Types of residence	Old multi-family	Rebuild Area A	Rebuild Area A	New multi-family
Percentage covered[a]	.....	68	50	50
Borough	Manhattan	Manhattan	Manhattan	Brooklyn
Street system	Fig. 2	Fig. 3	Fig. 3	Fig. 3
Population provided for	46,000	38,550	33,270	33,270
Persons per:				
Residential acre	678	731	540	540
Gross acre	287	241	208	208
Persons actually housed[b]	36,620	36,620	31,600	31,600

(*b*) Area Allocation

Description	Acres	% of gross	Acres	% of gross	Acres	% of gross	Acres	% of gross
Streets in use	56.88	35.55	42.08	26.30	42.08	26.30	42.08	26.30
Parks and playgrounds	4.79	2.99	22.05	13.78	19.02	11.88	19.02	11.88
Institutions	11.25	7.03	21.00	13.12	18.14	11.32	18.14	11.32
Business	14.88	9.30	22.15	13.86	19.15	11.96	19.15	11.96
Residence	67.83	42.40	52.72	32.94	61.61	38.54	61.61	38.54
Vacant	4.37	2.73	....	....	....	....	....	....
Total	160.00	100.00	160.00	100.00	160.00	100.00	160.00	100.00

[a] Percentage of residential land covered by apartments. [b] Persons housed after allowing for vacancies.

In order to measure public services in the existing area and to ascertain needs in the new units that could be reduced to comparable terms, it was necessary to find a common denominator. Accordingly, each of the communities studied is a type or specimen development predicated on a square containing 160 acres, measured to the center line of boundary streets, in order to secure comparability in one respect—namely, land area. It should be noted that the area of 160 acres, developed with apartments of the character assumed in this study, would house more people than could be efficiently served by one elementary school. Under the foregoing principles of the neighborhood unit, such a development might be served by several elementary schools.

Location of Communities Studied.—There is no particular advantage, however, in examining an area of 160 acres within designated boundary streets. The value of the findings could be easily prejudiced by conditions peculiar to a specific location. It is true that a number of unit costs vary, as between the

boroughs of New York City, due to differences in construction practices and in the extent to which certain city services are normally provided, but there is no significant variation within a borough. Approximate locations, within a well-defined section of a borough, furnish ample bases for determining the extent of public development existing in an area typical of that section and the costs of public facilities prevailing in the vicinity. The resulting cost estimates are more representative of average conditions for large sections of the city and, therefore, have broader implications.

Accordingly, Area A (see Fig. 1) is located within the East Harlem section of Manhattan; Units A_1 and A_2, the two schemes for rebuilding multi-family Area A, of course, are on the same site as Area A in East Harlem; and Unit A_3 is located on vacant land, adjacent to Jamaica Bay in Brooklyn, N. Y.

Land Use, Building Development, and Population

The area of land used for various purposes and the bulk of buildings determine the number of persons that can be accommodated in these communities. The population of the specimen communities must be ascertained before the extent and cost of public facilities can be investigated.

Land Use.—Two major factors are involved in allocating the 160 acres of these typical communities to street, residence, institution, park, and business uses—namely, area and population. The land required for street purposes is determined by the street plan, and in the old area both vacant land and streets are based on the extent of existing development. The land area needed for residence, parks, institutions, and business, however, is dependent upon the number of persons to be housed in a given community; hence, the extent of these land uses is predicated upon the service requirements of the community's population.

The "Area" Factor.—As shown in Figs. 2 and 3, the communities studied are developed on the two types of street systems: (1) The "normal" gridiron street plan; and (2) a master block arrangement.

Gridiron Street Plan.—The usual gridiron street plan existing in New York City is not directly adaptable to a theoretical community of 160 acres, in the form of a square measuring one-half mile on a side. Minor adjustments in the occurrence of the wider streets and avenues in relation to the local streets of standard width are, however, satisfactory for the purposes of this study. The gridiron street system was standardized in a "normal" pattern to permit direct comparisons between communities (see Fig. 2). The amount of land in Area A that is allocated to the gridiron street plan on this "normal" pattern is based upon the built-up experience of existing multi-family areas (see Tables 1 and 2). The boundary streets of Area A average 100 ft in width, and the "normal" gridiron system requires nearly 57 acres, or about 35% of the 160-acre gross area. Each block measures 575 ft by 200 ft.

Master Block Plan.—The master block arrangement indicated by Fig. 3 is used for Unit A_1, Unit A_2, and Unit A_3. This development plan of "super" blocks is designed to limit "through" traffic to boundary and major thoroughfares. Boundary streets of the 160-acre tract are each 140 ft wide, including a local service road. Each master block (1,200 ft by 535 ft) is surrounded by a

service roadway separated by a safety isle or planting strip from the wider through-traffic streets bounding the block. A single master block is equivalent to five ordinary blocks in the usual gridiron system, including the area devoted to four minor cross streets in the gridiron system but excluding the area needed for service roadways. The theoretical 160-acre community has eight such master blocks in two rows of four each. They are separated by three north-and-south streets, each 120 ft wide with service road, and by one east-and-west street, 100 ft wide, running through the center (see Fig. 4).

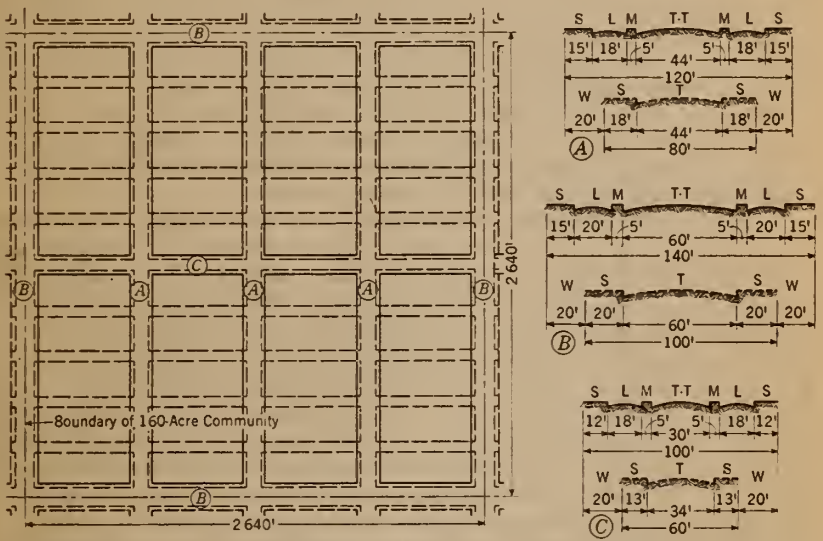

FIG. 4.—CONVERSION OF "NORMAL" GRIDIRON STREET SYSTEM OF AREA *A* TO MASTER BLOCK LAYOUT FOR UNITS A_1 AND A_2

This master block plan is applicable in the rebuilding of most of the old sections that are now developed on a "normal" gridiron street system and can be easily used for any neighborhood to be built on a vacant and relatively flat site. In this design, streets account for about 42 acres, or 26.3% of the 160-acre gross area.

"Population" Factors and Standards.—With the street pattern fixed, the next step in the determination of land use involved the allocation of the remaining acreage to the parks, institutions, business, and residential uses needed by the community's inhabitants.

Reference to Table 1 will recall that there are cemeteries and industries in the large communities surveyed by the Mayor's Committee on City Planning. Within these larger communities, however, there are many sections of 160 acres that do not contain either a cemetery or any significant industrial uses. For

the purpose of this study, therefore, such uses are excluded from all of the communities.

Uses in Terms of Population.—The extent of public services and private facilities needed in the neighborhood units is necessarily determined by the total number of people that can be housed in each community. In the case of an "old" development, it is reasonable to express land use and service needs in terms of the population that could live in the area if all available dwellings were occupied. Otherwise, any measurement of adequacy is based on a population figure which fluctuates with the changing occupancy of dwellings, and a facility deemed adequate for 80% occupancy is found insufficient when 90% of the dwelling units are occupied. In this study, therefore, any land use or facility depending upon the population factor is predicated on 100% occupancy of available family quarters. Real Property Inventory reports show that few of the "old" residential districts are fully occupied, but the newer and more modern housing developments usually have a "waiting list" of families that desire to move in as soon as a vacancy occurs.

It is believed that some of the buildings have become entirely vacant since 1934 and are boarded up or demolished; but subsequent new construction and alterations have probably added some family quarters in the existing multi-family areas. However, there are no data available to indicate the exact number of family quarters now existing in Area *A*. Consequently, the conditions revealed by the 1934 Real Property Inventory are used to estimate the population resulting from 100% occupancy of family quarters in Area *A*.

Built-Up Experience in Area A.—The analysis of selected existing multi-family areas, surveyed by the Mayor's Committee on City Planning, reveals that there would be 678 persons per residential acre if all family quarters were occupied. In Area *A*, the 678 persons per net acre are housed in apartments averaging 5.3 stories in height and covering 70% of the residential land.

Full occupancy of the family quarters provided in Area *A* determines the total population and extent of land used for residence, parks, institutions, and local business. Table 2 shows the number of acres and the proportion of gross land area used for each major purpose as well as the population provided for under built-up experience in the 160-acre specimen community, Area *A*. The acres per 1,000 persons of park, institution, and local business found in Area *A* are given in Table 1.

"Minimum Standards" in Units.—The extent of land required for each major purpose in the neighborhood units is predicated on the unit formula and the minimum standards for parks, institutions, local business, and housing, as follows:

Park and Playground.—Standards believed feasible in New York City, which were developed by the Mayor's Committee on City Planning, call for a minimum of one acre of park and playground per 1,750 persons. This allows for a playground, a small quiet park, and active recreation areas but excludes large parks.

Institutions.—Schools, fire stations, libraries, and other public and private buildings of a local character, as well as churches, are included under "Institutions." Because of the varying spheres of influence of such services, some

of which do not coincide with the 160-acre tract under consideration, the land allocated to institutions in each unit is based upon the average built-up experience of eleven residential communities studied by the Mayor's Committee on City Planning. This average is just more than one half of an acre per 1,000 persons, and is believed to be generally adequate.

Business.—Local business includes retail shops, garages, gas stations, laundries, cleaners, barbers, theaters, banks, amusements, local offices, and similar services that would be needed by the people of a self-contained residential community.

In this study the business standard is fixed at 50 ft per 100 people. With lots averaging 100 ft deep this is equivalent to one acre of business per 870 population in each neighborhood unit. Table 1 shows that about 0.3 acre per 1,000 people is used for commercial structures in the existing multi-family areas of the city. The remaining business frontage usually required to serve such communities is found on the ground floor of apartment buildings. Consequently, in Units A_1 and A_2 (the alternative schemes for rebuilding Area A), and in Unit A_3, it is assumed that one half of the required business frontage is on the ground floor of multi-family buildings and the remainder in commercial structures.

Residential Requirements.—In rebuilding Area A to rehouse the present population of 36,620 persons, provision is made in Unit A_1 for a normal vacancy of 5%. On this basis the new apartments must accommodate 38,550 persons. Allowing 242 sq ft of gross floor area per person, and buildings averaging six stories high, these apartments would cover approximately 68% of the net residential land. If land coverage is held to 50%, the buildings would average 8.15 stories in height. In either case there would be 731 persons per net residential acre compared with a potential density of 678 in Area A. This greater density in Unit A_1 results from the relatively larger land areas that are devoted to park, institutional, and business purposes under minimum standards, which reduce the area of land available for residence (compare Area A and Unit A_1 in Table 2). Although these other facilities may be considered adequate, the building bulk of apartments in Unit A_1 is believed to exceed a reasonable standard in overcrowding the land and is therefore considered obsolete.

It is assumed that the housing bulk resulting from 50% land coverage and six-story apartment buildings is the maximum development desirable under reasonable standards. At 242 sq ft of gross floor area per person, these apartments would accommodate 540 people on each residential acre. When properly designed, it is believed that such a development could offer sufficient amenities to maintain a desirable residential character despite the high density. Accordingly, this average building bulk is the housing "standard" in rebuilt Unit A_2 and in new Unit A_3.

Application of Factors and Standards.—Using the aforementioned factors and "standards," the requirements of the population for residence, park, institution, and business were determined for each of the neighborhood units. The resulting population and the land area allocated to these major uses are

given in Table 2. Inasmuch as the neighborhood units are fully developed, there is no vacant land.

Public Improvements and Services

This investigation attempts to ascertain the nature and extent of public improvements and services now provided in Area *A*. The land uses and degree of development in Area *A* are derived from the built-up experience of the larger communities of which this theoretical 160-acre area is a representative sample. Likewise, the character and extent of public improvements and services in Area *A* are determined from the built-up experience in the larger residential community of East Harlem. The average conditions revealed by public records to exist in East Harlem, when applied to Area *A*, indicate the public facilities now serving this theoretical 160-acre community.

The public services required to serve the neighborhood units adequately are determined on the basis of "minimum service standards," which are discussed herein. Practically all of the public facilities required to serve Unit A_3, which is situated on vacant land, must be entirely new improvements.

In the rebuilding of Area *A* on a master block plan, it is also necessary for the city to provide the adequate and up-to-date facilities needed under "minimum service standards" by the population rehoused in each of the alternative neighborhood schemes, Units A_1 and A_2. Therefore, it is assumed that: (1) Any public facility existing in Area *A* that is not adequate as measured by minimum service standards must be augmented in Units A_1 and A_2 to the full extent of the indicated deficiency; and (2) all existing public services in Area *A* are utilized in so far as needed, but those retained must be replaced in Units A_1 and A_2 to the full extent of the indicated obsolescence.

Improvements and Services Studied.—Only those permanent improvements and facilities supplied by the city that may be directly charged to a local community on the basis of services provided are included in this study. The needs for water supply reservoirs, courts, jails, hospitals, museum buildings, and other general services are not determined by the type of residential development, and they are influenced only indirectly by the geographic location of residential communities. In comparison with local neighborhood facilities, such improvements are city-wide services for which the needs are determined by the entire population and area of the city or a borough. In this study the public services discussed are considered essential to the proper functioning of self-contained residential communities.

Street Utilities.—Sidewalks, curbs, street paving, sewers, water mains, and street lighting are termed "street utilities" in this study. The installation of these utilities in New York City depends almost entirely upon the type of street plan and the various construction practices in each borough of the city rather than upon the number of people to be served.

The borough standards, quantities, and unit costs of street utilities are given in the Appendix. The "minimum service standards" for street utilities in the neighborhood units coincide with current practice in the boroughs, but the quantities needed, or course, are determined by the master block layout.

Population Facilities.—Population facilities include parks and playgrounds, elementary and high schools, branch libraries, district health buildings, fire and police stations, sanitation services, sewage and refuse disposal, and rapid transit. With the exception of rapid transit, which is located in public streets, population facilities are built upon a part of the "developed area" that is classified as "Institutions" in Tables 1 and 2.

The extent to which these public improvements and services are provided in Area *A* and are needed in the neighborhood units is determined by the population to be served. This does not imply that all such services existing in Area *A* are adequate to meet the needs of modern urban living, but rather that the basic requirements for these facilities are not dependent upon the land or "area factor" alone. For example, schools are provided to accommodate a given number of children, and the "area served" depends upon the size of the school and the density of population in the surrounding development. Other parallels can be drawn but the relationship between population and schools illustrates the general nature of "population facilities."

Practically all of these population facilities have been provided in the larger residential communities surveyed by the Mayor's Committee on City Planning. In general, small parks, schools, and sanitation services are entirely local in character, but the other population facilities may have sufficient capacity to take care of a greater number of people than are accommodated in a typical 160-acre community. Existing facilities with an "area of service" greater than 160 acres may not be located within the boundaries of a 160-acre district, and the extent of service available to each community must be based, therefore, on borough or city-wide measurements in relation to the needs of the population of each of the theoretical communities.

The public improvements and services in the neighborhood units that are dependent upon the population factor are identical to the population facilities supplied to Area *A*, and the same procedures are used to determine the extent of each service needed. The "minimum service standards" for parks and playgrounds, elementary schools, libraries, refuse disposal, and rapid transit service in the neighborhood units differ from current borough practices. City standards and departmental programs for the remaining population facilities are considered adequate for the units. The methods of determining needs, and the "standards" and charges against each community for population facilities, are outlined in the Appendix.

Obsolescence in Area *A*

In rebuilding Area *A* under the "standards" adopted for this study, it would be necessary to expand existing public services that are inadequate and to replace any depreciated facility to the full extent of indicated obsolescence.

Street Utilities.—Fig. 4 suggests the extent of alteration and rearrangement of "street utilities" involved in the change from the normal gridiron street system of Area *A* to the master block plan of Units A_1 and A_2. The changes, quantities, and costs involved are given in the Appendix.

Population Facilities.—Many of the existing population facilities serving Area *A* must be replaced in whole or in part when this old district is rebuilt

on the master block plan of Units A_1 and A_2. The obsolescence of population facilities serving Area *A* generally is predicated on the present age and useful life of these improvements.

The present age of facilities is obtained from public records, with the exception of libraries, fire stations, police precincts, and sanitation garages and section houses. It was assumed that the age of these facilities is equal to the average age of existing school buildings in East Harlem. The first school in this section, still standing in 1941, was built in 1867, but the average age of all schools in East Harlem is forty-three years. It seems reasonable to suppose that the average age of the aforementioned facilities in East Harlem will approximate the average age of schools.

The useful life of most population facilities is derived from the replacement experience of the appropriate public agencies. Whenever a facility reaches the limit of its useful life, replacement is assumed necessary for the satisfactory continuance of such service. The Appendix contains detailed information on the present obsolescence of public services in Area *A*.

Improvement Costs and Annual Expenses

The reported costs of existing improvements in old Area *A* are used when available. In other instances the estimates are derived from current contract prices reported by city agencies. The cost estimates for improvements in neighborhood units are based upon current practice and contract costs in the appropriate borough, or upon the estimated costs of proposed improvements. Land acquisition is estimated at 1.3 times the average assessed value per acre in each community, but all street land is assumed to be dedicated without cost to the city. The cost estimates for each kind of improvement or service are summarized in Table 3(*a*) by community.

The unit costs used in the estimates of annual expenses are derived from the most recent information available from the operating agencies. The per capita expenses, where used in this investigation, are generally obtained from reported total annual expense and the estimated population actually living in the city. The "actual" population living in each community, rather than the "demand" or total population that could be accommodated with 100% occupancy of dwelling units, is used, therefore, in determining annual expenses that are based on per capita costs.

The estimates of annual expenses indicate the expenditures of the city for operation and maintenance of public services provided in each community. No attempt is made to set up a "balance sheet" of annual expenses and of city revenue derived from a community. The estimates do not in any sense represent the amounts of taxes levied or collected in each community. Annual expenses in any of these residential areas may exceed the taxes paid to the city by the particular community, but the expenses must be met from general city revenues in any event. The estimated yearly expenses charged to each community are summarized in Table 3(*b*), and the procedures in this work are outlined in the Appendix.

Meaning of Estimates.—The estimated costs of permanent improvements represent the present investment of the city in the public facilities now found

in Area A without any allowance for depreciation or for replacement of the original improvements. The estimates of annual expenses represent the costs to the city for operation and maintenance of existing public services, some at less than capacity because of the relatively low occupancy ratio in dwellings of Area A.

TABLE 3.—Estimated Total Costs to the City

No.	Description	Area A	Unit A_1	Unit A_2	Unit A_3
	(a) For Permanent Improvements				
1	Sidewalk and curb	$ 341,730	$ 145,960	$ 145,960	$ 72,872
2	Street paving	467,626	334,740	334,740	373,146
3	Sewers, etc.	1,070,700	324,450	324,450	310,220
4	Water mains, etc.	151,800	43,660	43,660	133,420
5	Street lighting	.....	23,410	23,410	23,410
6	Parks and playgrounds	1,767,550	1,045,850	133,140	383,140
7	Elementary schools	1,740,000	1,672,000	1,365,000	1,936,000
8	High school	2,210,000	450,000	388,500	1,597,500
9	Public library	150,900	69,000	59,500	84,250
10	Health building	50,400	.....	.....	76,600
11	Fire station, etc.	196,600	75,200	65,900	84,100
12	Police precinct	104,250	69,100	39,400	41,600
13	Sanitation	101,890	61,200	52,800	47,676
14	Sewage disposal	987,000	.....	.....	431,000
15	Refuse disposal	70,000	28,650	21,650	65,000
16	Rapid transit	1,655,000	1,626,800	783,400	7,080,600
17	Total	$11,065,446	$5,970,020	$3,781,510	$12,740,534
	(b) For Annual Operation and Maintenance Expenses				
18	Street cleaning	$ 96,430	$ 77,063	$ 77,063	$ 56,826
19	Sewer maintenance	2,063	905	905	874
20	Water mains	6,188	2,652	2,652	2,694
21	Street lighting	6,200	1,468	1,468	1,468
22	Parks and playgrounds	2,520	11,575	9,986	9,986
23	Elementary schools	559,000	470,000	405,700	405,700
24	High school	292,560	245,100	211,630	211,630
25	Public library	31,750	26,985	23,275	23,275
26	Health building	2,820	2,150	1,860	2,160
27	Fire protection	153,500	153,500	132,400	99,860
28	Police protection	252,750	252,680	218,000	101,760
29	Refuse removal	79,758	79,758	68,825	63,895
30	Sewage disposal	23,550	19,720	17,050	17,730
31	Refuse disposal	19,987	18,392	15,872	13,248
32	Debt service on rapid transit	80,900	160,400	119,200	346,000
33	Total annual expenses	$ 1,609,976	$1,522,348	$1,305,886	$ 1,357,106

The costs of public improvements in the neighborhood Unit A_3 represent the investment that the city must make to provide new public services that are adequate under minimum service standards. The estimated costs of permanent improvements in the rebuilt communities, Units A_1 and A_2, represent the city expenditures necessary to make existing deficient services adequate and to replace the obsolete part of the present plant that is retained in rebuilding the old apartment Area A. The estimates of annual expenses indicate the costs to the city for operation and maintenance of public services in the neighborhood units with 95% of the available housing occupied.

Total and Per Capita Costs.—Rapid transit is not the same kind of local improvement as elementary schools and similar neighborhood facilities. However, transit has exerted a tremendous influence upon the direction and extent of residential development. Since 1900 about 85% of New York's population has lived within one-half mile of rapid transit lines. Urban life depends upon mobility of people as well as goods. Rapid transit, therefore, is considered essential to the life of residential communities in New York City. Rather than permit the transit factor to complicate these findings, the estimated costs will be examined, first with transit charges and second excluding transit charges.

The findings will be considered on the basis of "costs per person housed" in each area. The "costs per person housed" are based upon the actual population living in each area after allowing for vacancies.

With Rapid Transit Charges.—Total improvement costs in new Unit A_3 are 1.15 times the costs in old Area A, and the costs per person housed in Unit A_3 are 1.33 times the per capita costs in Area A (see Table 4(a)).

TABLE 4.—Estimated Total and per Capita Costs

Area and units	(a) With Rapid Transit				(b) Without Rapid Transit			
	Improvement Costs		Annual Expenses		Improvement Costs		Annual Expenses	
	Total	Per person	Total	Per person	Total	Per person	Total	Per person
A	$11,065,446	$302.16	$1,609,976	$43.96	$9,410,446	$256.97	$1,529,076	$41.75
A_1	5,970,020	163.02	1,522,348	41.57	4,343,220	118.60	1,361,948	37.19
A_2	3,781,510	119.66	1,305,886	41.32	2,998,110	94.87	1,186,686	37.55
A_3	12,740,534	403.18	1,357,106	42.94	5,659,934	179.11	1,011,106	31.99

Per capita improvement costs for new Unit A_3 are much larger than the costs involved in rebuilding old Area A; costs per person housed in Unit A_3 are 3.3 times the cost in rebuilt Unit A_2 and 2.4 times the per capita costs in rebuilt Unit A_1. This is significant because the rebuilt Units A_1 and A_2 provide additional services to meet present deficiencies of old Area A, and because the deteriorated parts of existing facilities are replaced to the full extent of the indicated obsolescence. It is also interesting to note that the city needs to spend less than $120 per person to house a population of 31,600 in Unit A_2, compared to $163 per person to house 36,620 people in Unit A_1.

Annual expenses per person housed do not vary as much between the several communities as improvement costs. The range is from $41.32 in Unit A_2 to nearly $44 in Area A. The higher total and per capita expenses in Area A suggest that public services in deteriorated old sections are not utilized efficiently. The costs per person housed in new Unit A_3 are $42.94, as against $43.96 in Area A and $41.57 in rebuilt Unit A_1 (see Table 4(a)).

Excluding Transit Charges.—If rapid transit should become an entirely self-sustaining service, the costs to the city for improvements in residential developments would be reduced accordingly. The exclusion of transit charges reduces the remaining improvement costs in new Unit A_3 to about 60% of

those in old Area A; but the costs in Unit A_3 are 1.3 times the costs in rebuilt Unit A_1 and nearly 1.9 times the costs for improvements in Unit A_2 (see Table 4(*b*)).

In terms of persons housed, the costs are lower in the rebuilt units than in the new development. In new Unit A_3 the improvement costs per person housed are 1.5 times the costs in rebuilt Unit A_1, and about 1.9 times more per person than need be spent in rehousing an equivalent population in rebuilt Unit A_2.

Annual operating expenses are lower in new Unit A_3 than in other communities when transit charges are deducted. Per capita service expenses are generally higher in Manhattan, and in many instances a larger measure of service is provided than in Brooklyn. The expenses per person housed in new Unit A_3 are about 75% of the expenses in Area A, and approximately 83% of expenses in Units A_1 and A_2.

Rehabilitation Versus Decentralization

The surprisingly low per capita cost for the rebuilt Unit A_2 is particularly interesting. The conditions existing in Area A are indicative of the deficiencies of older residential districts in central parts of the city. The average age of this development exceeds forty years; some of the public facilities and private structures are more than seventy years old.

Certain public services are inadequate as measured by the standards adopted for this study, and many existing public improvements are nearing a point of deterioration that will shortly necessitate their replacement. A variety of circumstances have contributed to the high vacancy in apartments, among others being: (1) The heavy vehicular traffic passing through the district on local streets; (2) an influx of commercial and industrial activities into residential blocks; (3) too great a density of buildings and people on the land; and (4) a hesitancy of owners to modernize old housing. Private owners do not wish to increase their investment in old buildings because of the uncertain outlook for individual properties and the hope of putting the land to a more intensive use. This hope has not materialized, but modernization is difficult because many properties have not been amortized over the years of productive use. These and other circumstances make Area A an unstable district, and the lack of bold correctives further contributes to this unhealthy condition. It is only natural that people should move from districts like Area A whenever they can afford to locate in newer, outlying sections that offer a more desirable residential environment.

When population shifts from older districts to newer developments, the city must provide additional street utilities and population facilities in the new sections to meet the resulting demands. There are enough people left in the older districts, however, to require the maintenance of public services. Consequently, the city is in reality forced to duplicate existing facilities in the newer developments and at the same time to operate the old plant below capacity.

The older residential districts cannot be abandoned entirely and left to stagnate; nor are the people willing to remain in these undesirable neighborhoods so long as modern private developments and cheap transportation

enable them to live more pleasantly in outlying communities. What can be done to remedy this apparent impasse? Under present tax structures the city cannot continue this inefficient and expensive process unless it is to face bankruptcy or to experience a far greater population growth than the more optimistic prognosticators now foresee.

This investigation suggests that, in so far as city expenditures are concerned, it would be economical and desirable to rehabilitate deteriorated residential districts completely on the neighborhood unit scheme. A brief examination of the current obsolescence of public services will reveal the extent of investments to be salvaged in this process and the cost of rehabilitation as against decentralization.

Public Facilities in Area A.—Table 3 shows that the costs to the city, for modernization of existing public facilities in Area A on the master block scheme of the neighborhood Unit A_1, amount to about $6,000,000, or $163 per person housed. This value does not indicate the exact obsolescence of existing public facilities because of the changes in street utilities necessitated by the conversion of the present gridiron street system of Area A into the master block plan. The extension of population facilities required by minimum service standards also calls for a greater expenditure than is necessary merely to replace the obsolete part of the existing plant. A calculation of the costs of replacing obsolete public facilities in Area A, without changing the present gridiron street plan, shows that a total outlay of about $4,900,000 would be needed. Of this total, replacing obsolete street utilities would require $850,000 and merely replacing obsolete population facilities would involve expenditures of more than $4,000,000. The replacing of obsolete facilities without altering the gridiron street plan of Area A, or supplying adequate parks, is herein termed operation "Re-Area A."

Assuming that the $11,065,446 cost to the city for improvements now existing in Area A is the original public investment, the estimated expense of replacing deteriorated parts is 44.3% of this original cost. In other words, it appears that public facilities in Area A are already 44% obsolete and must be replaced shortly in order to maintain city services for the 36,620 persons living in this community. This of course excludes replacing such new improvements as the sewage disposal plant and a local health building.

Replacing Facilities with Adequate Parks.—When the city does replace obsolete facilities in old Area A, it would be preferable to provide the additional park acreage required under minimum service standards to serve the present population. The Appendix shows that the transformation of the gridiron street system into the master block plan makes it possible to obtain new park acreage by utilizing the land available from interior streets, which are discontinued. In the case of Unit A_1, the required total park acreage exceeds the sum of existing park area plus leftover street area by only 2.5 acres. On this basis the city needs to purchase 2.5 acres of additional land to meet the park requirements of Unit A_1.

By rehabilitating public improvements in old Area A without changing the existing gridiron street system to the master block plan, the city would not be able to discontinue any local streets. As a result, it would be necessary to

purchase more than 17 acres of land which, with the 4.8 acres now in parks, would provide the 22 acres of parks and playgrounds needed to serve, adequately, the present population of old Area *A*. This operation can be designated as "New Area *A*."

With land acquisition at 1.3 times the average assessed value and development costs at $7,000 per acre, parks cost more than $6,400,000 in this rehabilitation operation for New Area *A* under minimum standards. The replacement of obsolete street utilities and population facilities, other than parks, requires the same expenditure as in Re-Area *A*—namely, about $4,900,000. The total cost of up-to-date public facilities in New Area *A* on the old gridiron street plan exceeds $11,300,000, or $308 per person housed.

Cost Ratios Per Person.—It is significant to find that the rebuilt Unit A_2 is less costly in respect to public services than "Re-Area *A*," "New Area *A*," or the new Unit A_3. Because of this finding the per person cost ratios in Table 5 are based on the cost in Unit A_2 as 100.

TABLE 5.—City Expenditures Per Person

(With Transit Charges)

Community	Improvement Costs		Annual Expenses	
	Per person	Ratio	Per person	Ratio
Old Area A[a]	$ 302	252	$43.96	106
Re-Area A[a]	134	112	42.15	102
New Area A[a]	308	258	42.30	102
Unit A_1[a]	163	136	41.57	101
Unit A_2[b]	119	100	41.32	100
Unit A_3[b]	403	337	42.94	104

[a] Population housed is 36,620 persons.
[b] Population housed is 31,600 persons.

The replacement of obsolete public facilities, without altering the gridiron street plan of Area *A*, would cost the city 12% more with present park acreage and nearly 2.6 times more with adequate park area than the rebuilding of old Area *A* on the master block scheme of Unit A_2. The rebuilding of Area *A* on the master block plan of Unit A_1 would cost only slightly more than merely replacing obsolete facilities for Re-Area *A*, but less than for New Area *A*.

The replacing of obsolete facilities for Re-Area *A* and New Area *A* would not, however, produce the social and economic results believed possible with the neighborhood unit communities on a master block plan. Such replacement of public facilities would tend to "freeze" the present character of private development on the unsatisfactory gridiron street plan, and to postpone the necessarily bold public and private corrective measures for at least another fifty or seventy-five years. By that time it is probable that the social and economic conditions of this community will become quite chaotic, unless present trends could somehow be arrested.

The advantages of the neighborhood unit schemes, having already been enumerated, will not be repeated. It is surprising to find, however, that such sound types of redevelopment as the neighborhood Units A_1 and A_2 also have cost advantages over the replacement of obsolete facilities, both for permanent improvements and annual operation. The entirely new neighborhood Unit A_3 is much more expensive than the several types of rehabilitated communities. When one recalls that, to a considerable extent, the public facilities in this

new unit would duplicate city services now provided in other sections of the city that are already built up, the apparently favorable ratio for operation in Unit A_3 is reduced accordingly.

These findings are not entirely conclusive, but they indicate that large-scale rehabilitation of old central apartment districts is economically feasible and preferable to new developments in outlying sections in so far as city expenditures are concerned. When one considers that all residents pay local taxes, which are obviously increased through duplication of city services, the case of rehabilitation versus decentralization becomes a question of public concern. It would seem, therefore, that essential studies of the private costs involved, and of the procedures to be used in large-scale rehabilitation of entire neighborhoods, should be undertaken immediately under a joint private and public sponsorship.

Acknowledgments

The original investigations, from which this paper is drawn, were made during 1939 for the Department of City Planning of the City of New York to ascertain the relative costs of public services in various types of residential developments. Commissioner R. G. Tugwell (who heads the Department and is Chairman of the City Planning Commission) has been kind enough to release the material for this paper prior to publication of the full report on the original study.

APPENDIX

The extent of public services existing in Area A, the standards used to determine the needs for improvements in the neighborhood units, the obsolescence of facilities now provided in Area A, and the cost estimates are outlined herein.

The reported costs of existing improvements in old Area A are used when available. In other instances the estimates are derived from current contract prices reported by city agencies. The cost estimates for improvements in neighborhood units are based upon current practice and contract costs in the appropriate borough, or upon the estimated costs of proposed improvements. Land acquisition is estimated at 1.3 times the average assessed value per acre in each community, but all street land is assumed to be dedicated without cost to the city.

Street Utilities.—The quality of street utilities is fixed by construction standards in the various boroughs, and the quantity is determined by the street plan and character of development. The quantities and unit costs (based on recently reported contract prices) are summarized in Table 6.

Sidewalks and Curbs (Item No. 1, Table 6).—Sidewalk standards in Manhattan call for 7 in. of cinders, 4 in. of concrete, and 1 in. of cement with steel-faced concrete curbs. The Brooklyn standard is 6 in. of cinders and 5 in. of concrete. Straight curbs are concrete in Brooklyn, but granite is used for corners and 3 ft beyond the corner curve.

Street Paving (Item No. 2, Table 6).—One half the cost of paving the through traffic roadway of boundary streets is charged to each community; but the service roadway adjacent to boundary streets in the master block plan, as well as other paving within the community, is charged in full to the neighborhood units.

TABLE 6.—STREET UTILITIES

No.	Item	Area A		Units A_1 and A_2		Unit A_3	
		Quantity	Unit cost	Quantity	Unit cost	Quantity	Unit cost
1	Sidewalk (sq ft)	962,192	$ 0.20	409,040	$ 0.20	282,040	$ 0.20
	Curb (lin ft)	66,352	2.25	28,512	2.25	27,712	0.50
	Curb (lin ft)	.....	.....	.....	.....	192	2.50
	Curb (lin ft)	.....	.....	.....	.....	608	3.50
2	Street paving (sq yd)	34,800	3.50	8,081	3.50	80,800	2.55
	Street paving (sq yd)	122,200	2.83	61,524	2.83	61,478	2.20
	Street paving (lin ft)[a]	.....	.....	58,592[a]	2.25	57,696[a]	0.50
	Street paving (lin ft)[a]	.....	.....	.....	.....	384[a]	2.50
	Street paving (lin ft)[a]	.....	.....	.....	.....	512[a]	4.00
3	Sewers (lin ft)	35,690	30.00	15,450[b]	30.00	29,110	5.50
4	Water mains (lin ft)—20 in.	2,640	9.00	2,640[c]	9.00	2,640	9.00
	Water mains (lin ft)—12 in.	5,280	5.00	5,280[c]	5.00	5,280	5.00
	Water mains (lin ft)— 8 in.	29,040	3.50	7,920[d]	3.50	23,760	3.50
5	Street lighting—units	.....	.....	176	132.50	176	132.50

[a] Curbs for safety islands in master block layout. [b] 70% of length shown obsolete and replaced. [c] 50% of length shown obsolete and replaced. [d] 66% of length shown obsolete and replaced.

Paving standards are as follows: In Manhattan heavily traveled streets have 3 in. of asphalt on a 9-in. concrete base; other streets are paved with 3 in. of asphalt on a 6-in. concrete base. In Brooklyn heavily traveled streets have an 8-in. concrete base; otherwise the practice is the same as that for Manhattan.

In changing Area A to the master block layout, new sidewalks and curbs are required for all of the local traffic streets and new curbs for one side of the safety islands. Service roadways will have to be newly paved to the full widths and lengths indicated in Fig. 4. It is assumed that the surfaces of existing roadways retained in the master block scheme are in good condition but that curb replacement in connection with safety islands requires repaving of 10% of the road surface retained in the master block plan. Any other incidental repaving is considered a maintenance item rather than a permanent improvement.

Sewers (Item No. 3, Table 6).—There are no trunk sewers in the Manhattan communities, Area A and Units A_1 and A_2; but trunk sewer costs for Unit A_3 are estimated on a flat rate of 3 cents per sq ft of "buildable" area. Catch basins, inlets, and manholes are included in the costs since sewers serve as combination storm-water and sanitary drains. One half of the cost of sewers in boundary streets is charged against each community.

Standards in Manhattan call for sewers averaging 4 ft by 2.33 ft. In Brooklyn the average is 18 in., but, due to the long blocks, sewers in Unit A_3 are assumed to average 24 in. and are placed in service roadways.

The average age of sewers in Area A is seventy years and their useful life one hundred years, so that 70% of the sewers in existing streets that are retained in the public streets of the master block plan require replacement in either Unit A_1 or A_2. New surface drains are also required for the service roadways in the master block schemes.

Water Mains (Item No. 4, Table 6).—The costs of water mains include valves, fire hydrants, and manholes but exclude all house connections, which are made at the expense of the property owner. One half the cost of water pipes in the boundary streets is charged to each community, except for Unit A_3, where current practice would require the original installation of water mains in each of the service roadways of the master block plan, rather than a single pipe in the bed of boundary and interior streets.

According to records of the New York Department of Water Supply, Gas and Electricity, the average age of water mains in East Harlem is fifty years. The useful life of 12-in. and 20-in. lines is about one hundred years and for 8-in. pipe, seventy-five years. On this basis, one half the 12-in. and 20-in. mains and two thirds of the 8-in. pipes in Area A are obsolete and that portion retained in either Unit A_1 or A_2 would have to be replaced. Obsolete fire hydrants must also be replaced, and new and old hydrants relocated to conform to the master block plan.

Street Lighting (Item No. 5, Table 6).—Under current standards and prices lighting equipment for the neighborhood units costs $93.36 per light. The installation is estimated at $39.15 per light.

The city formerly rented street lighting equipment from utility companies; hence there is no city outlay for this equipment in Area A. Under present policy the city purchases and installs street lighting equipment. Both the new and rebuilt communities are therefore charged in full for this equipment as noted in Table 6.

Population Facilities.—The character of development and the size of the population that can be accommodated in a community create well-defined demands for parks and playgrounds, elementary and high schools, branch libraries, local health buildings, fire stations and police precincts, sanitation garages and section houses, sewage and refuse disposal plants, and rapid transit. These public services are termed "population facilities."

The obsolescence of existing facilities in Area A is determined by the present age and useful life of these improvements. The present age of most facilities is obtained from public records, but the age of libraries, fire stations, police precincts, and sanitation garages and section houses is assumed equal to the average age of existing schools in East Harlem, which is forty-three years. The useful life of these facilities is considered to be sixty years; hence they are 71.6% obsolete.

Parks and Playgrounds.—Table 2 shows that public parks and playgrounds account for 4.79 acres, which is equivalent to one acre for each 7,100 persons that can be housed in the community. The park land required in the neighborhood units is based on standards used by the staff of the Mayor's Committee on City Planning, which call for one acre for each 1,750 persons.

Closing certain interior streets in converting the gridiron street plan of Area A into the master block layout of Units A_1 and A_2 makes about 14.8 acres of land available for other purposes (see Fig. 4). Inasmuch as this land is now in the bed of publicly owned streets, it is assumed to be a city asset, which could be sold or traded for building purposes in exchange for equivalent acreage in appropriate locations for additional parks at no cost to the city.

In Unit A_1 the 4.79 acres (see Table 7) of existing parks plus 14.8 acres from discontinued streets would produce 19.59 acres of parks. The purchase of 2.46 additional acres would bring park acreage to the 22.05 acres required in Unit A_1. For Unit A_2 the existing park acreage plus the area of discontinued streets would provide the 19.02 acres needed for parks and would leave about 0.5 acre that could be used for other public purposes.

TABLE 7.—Park Needs

Unit	Area, in acres	Land cost	Development ($7,000 per acre)
A	4.79	$1,734,000	$ 33,550
A_1	22.05	891,500	154,350
A_2	19.02	.....	133,140
A_3	19.02	250,000	133,140

The extensive reconstruction involved in transforming Area A to a master block plan would necessitate the redevelopment of parks and the provision of new park equipment in either Unit A_1 or A_2. The existing park equipment in Area A, therefore, is assumed unusable in Unit A_1 or A_2.

Elementary Schools (Table 8(a)).—The number of children from each unit that may be expected to register in public elementary schools is estimated at 9.7% of the total population. The elementary school standard limits class-

TABLE 8.—Educational Needs

Area and units	(a) Elementary Schools			(b) High School			(c) Public Library			
	Student registration	Needed classrooms	Rooms replaced	Registration (seats)	Percentage of seats replaced	Unit cost (dollars)	Persons per branch	Ratio of use	Replacement ratio	Cost of branch (dollars)
A	4,462	127.4	....	1,840	....	1,200	50,750	90.6	....	166,600
A_1	3,740	106.8	79.6	1,542	24.3	1,200	50,000	77.1	71.6	89,600
A_2	3,227	92.2	65.0	1,331	24.3	1,200	50,000	66.5	71.6	89,600
A_3	3,227	92.2	....	1,331	....	1,200	50,000	66.5	....	126,520

rooms to thirty-five students, and the school needs of each unit are predicated on this average value.

Records of the Board of Education of New York City show that 79% of the classrooms available in East Harlem are in buildings that were erected prior to 1901. These buildings generally cover more than three quarters of plots averaging only 31,200 sq ft in area. It is assumed, therefore, that about 80% of the 127 classrooms available to Area A are obsolete so that only 27 classrooms in buildings less than forty years old are considered usable in Unit A_1 or A_2.

Unit A_1 needs about 107 classrooms, of which 27 are supplied by existing schools, and nearly 80 must be provided in new buildings to replace obsolete classrooms. Unit A_2 requires about 93 classrooms, and, by utilizing the 27 now usable in Area A, new schools containing only 65 classrooms need be built to meet the requirements of Unit A_2.

Since fewer classrooms are needed for Units A_1 and A_2, it will not be necessary to acquire more land for schools. If the new playgrounds required under minimum standards were located adjacent to school sites, both old and new buildings in Unit A_1 or A_2 would have more light, air, and play space than is now available in Area A.

Reports of the Board of Education indicate that the accumulated cost of land, equipment, and building for existing elementary schools in East Harlem average $13,650 per classroom. Elementary school costs in all of the neighborhood units are based on $21,000 per classroom, a city-wide average for schools constructed during recent years.

High Schools.—Approximately 4% of the population of each unit is expected to register in public high school. The standard requires the provision of one seat per student in an up-to-date school building.

On the premise that buildings more than forty years old are obsolete, the Manhattan high school plant measured in classrooms is 24.3% depreciated. This obsolescence factor is applied against the number of old seats needed in Units A_1 and A_2 to determine necessary replacement. The cost per seat for land, building, and equipment (see Table 8(b)) is a general average for high schools recently constructed.

Public Library.—The standard used by the Mayor's Committee on City Planning forms the basis for determining public library needs in the units.

The obsolescence of the branch library serving Area A is estimated at 71.6%. In either Unit A_1 or A_2 the need for library service is less than that required by Area A. It is assumed that the obsolete part of this existing branch must be replaced to the full extent of the indicated depreciation.

As evidenced by capital budget and program requests, branch libraries cost about $125,000 each for construction and equipment. This sum forms the basis for cost estimates in all communities, exclusive of plots 50 by 100 ft, which are assumed to cost 1.3 times the average assessed value. The charge to each community is determined by the "ratio of use" (see Table 8(c)), which, of course, is population expressed as a percentage of the capacity of a branch library.

Health Building.—The Health Department program for health education, preventive medicine, and local health service aims at the eventual provision of health center buildings throughout the city. The capacity of each health building under this program forms the "standard," and costs are obtained from the same source. The "ratio of use" (Table 9(a)) determines the charge against each community (see also Table 3(a)). The district health center now serving Area A is adequate for Units A_1 and A_2, and this building is so new that obsolescence is negligible.

Sanitation.—The present distribution of sanitation garages and section houses in each borough is assumed a satisfactory standard for all communities.

In Manhattan there is one sanitation truck for each 1,540 persons and one section house for each 32,300 residents. In Brooklyn the averages are 2,540 persons and 44,350 persons respectively. Data from the Department of Sanitation indicate that trucks require about 6,300 cu ft of garage space, which, at 35 cents per cu ft, amounts to $2,205 per truck. Section houses for the storage of street cleaning and sanitation equipment average $25,000 each.

TABLE 9.—Health and Sanitation

Area and units	(a) Health Building			(b) Sanitation Buildings			(c) Sewage Disposal			(d) Incinerators		
	Persons per building (thousands)	Ratio of use	Cost of building (thousand dollars)	Garages (dollars)	Section houses (dollars)	Replacement percentages	Persons per plant (thousands)	Ratio of use	Plant cost (thousand dollars)	Daily collection (cu yd)	Ratio burned (%)	Capacity (cu yd)
A	227.4	20.2	50.4	1.44	0.76	....	1,270	3.62	27,255	471.5	44.4	209.5
A_1	227.4	....	....	1.44	0.76	71.6	1,270	....	....	395.3	57	225.5
A_2	227.4	....	....	1.44	0.76	71.6	1,270	....	....	341.2	57	195
A_3	250.0	13.3	76.6	0.87	0.56	....	400	8.32	5,176	341.2	57	195

The per capita costs, estimated on the basis of current distribution of these facilities in each borough, are shown in Table 9(*b*). The total charges to each community are derived from the population and appropriate per capita value. In Area *A* depreciation is estimated at 71.6% and the charges in Table 3(*a*) for Units A_1 and A_2 are to cover replacements of obsolete plant only.

Sewage Disposal.—Sewage disposal is assumed essential in all of the communities, and the program for plants and treatment methods proposed by the Department of Public Works is taken as the standard. Costs are also derived from this source. Units A_1 and A_2 are served by the new Wards Island plant; Unit A_3 would be served by the proposed 26th Ward plant in Brooklyn.

The Wards Island disposal plant is practically new, and its capacity is adequate to serve either Unit A_1 or A_2. Hence, no replacement nor enlargement of existing sewage disposal facilities is involved in rebuilding Area *A* on the master block plan. Area *A* and Unit A_3 are charged according to the ratio of use (see Table 9(*c*)) of the rated capacity of the plants serving their population.

Refuse Disposal.—It is assumed desirable to incinerate all combustible material and to use only ashes and other inorganic refuse for land fill. Estimates made for the Mayor's Committee on City Planning show that 57% of the refuse is combustible material and the remainder is inorganic matter that can be disposed of by land fill. About 45% of the refuse from Area *A* is now incinerated (see Table 9(*d*)). It is assumed that land acquisition is not involved in disposing of the remaining refuse by the land-fill method.

The charges for refuse disposal are based on the use of incinerators of 750-ton daily capacity costing $1,500,000. Combustible material from each community is figured at approximately 600 cu yd per ton.

Estimated daily collection of all refuse is based on 3.2 cu yd per capita annually at 313 working days. The existing plant serving Area *A* handles 209.5

cu yd and is assumed 33% obsolete. An additional capacity of 16 cu yd is needed for the 225.5 cu yd to be incinerated in Unit A_1. New plant costs chargeable to Unit A_1 are \$5,350 and replacement of obsolete part, \$23,300. The 195-cu-yd capacity needed in Unit A_2 is 15 cu yd less than the existing plant serving Area A; this excess can be used for another community, and Unit A_2 is charged only for replacement of the obsolete part of the capacity of the old incinerator needed to serve this rebuilt community.

Fire Station.—The present distribution of fire stations in each borough is assumed adequate for the protection of residential neighborhoods. The existing facilities serving Area A are assumed 71.6% obsolete (see Table 10(a)) and to require replacement to this extent.

TABLE 10.—Fire and Police Buildings

Area and units	(a) Fire Station Needs				(b) Police Precinct Buildings			
	Persons per station	Ratio of use	Replacement ratio (%)	Cost per station (dollars)	Persons per building	Ratio of use	Replacement ratio (%)	Cost per building (dollars)
A	30,400	151.0	....	116,600	68,000	67.6	....	154,100
A_1	30,400	126.3	71.6	53,600	68,000	56.7	71.6	122,200*
A_2	30,400	109.3	71.6	53,600	68,000	48.9	71.6	80,600
A_3	37,400	89.0	....	76,520	92,400	36.0	....	115,540

* Additional land included in total replacement cost.

The total cost of stations is estimated at \$75,000 per building plus 5,000 sq ft of land at 1.3 times the average assessed value of each community. The charge to each community, of course, is based upon the "ratio of use" shown in Table 10(a).

The fire alarm telegraph system now uses underground conduits and alarm boxes at approximately every alternate street intersection. On the normal gridiron layout, this calls for twenty alarm boxes per community. The master block plan, however, needs only sixteen alarm boxes per unit. Installation costs, at \$1,000 per box, are \$20,000 for the gridiron street plan and \$16,000 for the master block plan. One half of the twenty existing boxes in Area A are assumed obsolete, but four of the boxes not needed in Unit A_1 or A_2 have a salvage value of \$200 each, which reduces the replacement cost to \$7,200 in each of these units.

Police Precinct.—The standards for police protection for all communities are also based upon the present distribution of precinct buildings in each borough. The obsolescence of police stations serving Area A is the same as fire stations—namely, 71.6% (see Table 10(b)). Replacement to this extent is necessary for Units A_1 or A_2. Most of the old police precincts occupy plots 50 ft wide, but garages for motor equipment adjacent to new stations require lots 100 ft wide. In Unit A_1 the additional land must be acquired. After providing for park needs in Unit A_2, however, sufficient land would be left over from discontinued interior streets to allow for the larger police station lot.

The costs charged to each community (see also Table 3(*a*)) are based on the respective ratios of use, with buildings at $112,500 each and land at 1.3 times the average assessed value.

Rapid Transit.—This study assumes that adequate transit service is essential to the proper functioning of the neighborhood unit communities. The measure of adequate transit service during the morning rush hours (see Table 11) is predicated on "reasonable" carloadings, as defined by the Transit Commission, and sufficient capacity on lines to transport the passengers contributed by each unit with out exceeding this "reasonable" load.

TABLE 11.—Morning Rush-Hour Passengers

Area and units	Percentage of population	Total load	I.R.T. subway	Independent subway	Elevated lines
A	14.4[a]	5,178	3,791	.....	1,387
A_1	14.4[b]	5,450	4,140	1,310	.....
A_2	14.4[b]	4,705	4,140	565	.....
A_3	18.8[b]	6,255	.....	6,255	.....

[a] Ratio of actual population. [b] Ratio of population at full occupancy of housing.

The "reasonable" carload (about 3 sq ft per standing passenger with all seats filled) does not represent the most desirable or convenient transportation, but it is a practical basis for measuring line capacity. Besides carloading, two other factors are involved in determining the capacity of transit lines serving each unit: (1) The number of cars per train, and (2) the headway between trains during the morning rush hours. Adequate transit service, therefore, must provide sufficient capacity to carry the passengers contributed by each unit, as well as by the remaining half-mile zone served by each line, without exceeding "reasonable" carloadings during the morning rush hours on any line into central business districts. In 1935 the Interborough Rapid Transit Company (I.R.T.) was carrying loads during the morning rush hours that are estimated to be 1.2 times greater than the reasonable capacity of the line serving East Harlem. As a result, the actual number of persons living in Area *A* is used to determine rush-hour loads. In the neighborhood units, the population that could be housed at full occupancy of dwellings determines the loads and the capacity required.

Table 11 shows the estimated rush-hour passengers contributed by each community and the number using each rapid transit line. Of the total passengers contributed by Area *A*, only 83% of those using the I.R.T. subway are assumed within the capacity of this line because of the present overcrowding. With certain remedial measures it is believed possible to increase the capacity of this line by 1.3 times during the morning rush hours. This would increase the present 3,165-passenger reasonable capacity of the I.R.T. subway available to Area *A* to 4,140 rush-hour passengers.

In rebuilding Area *A* it is supposed that the obsolete elevated lines serving East Harlem will be demolished and that remedial measures will be undertaken on the I.R.T. subway. Thus, all traffic from Units A_1 and A_2 must use subway lines, including a new subway to replace the Elevated Railway.

Unit A_1 will contribute 5,450 rush-hour transit passengers, of which 4,140 are expected to use the I.R.T. subway, and 1,310 passengers will have to be

accommodated on the new subway line that will be needed after demolition of the Elevated Railway. Unit A_2 is expected to contribute 4,700 passengers during the morning rush hours. With the reasonable capacity available after remedial measures, the I.R.T. can serve 4,140 of these people, and the new subway line will accommodate the remaining 565 passengers from Unit A_2.

The Elevated line in East Harlem was built at private expense and cannot be charged against Area A. On the basis of total city contributions to the I.R.T. subway construction, it is estimated that the city's capital outlay averages $437 per passenger carried during rush hours in 1935. According to studies of the Mayor's Committee on City Planning, remedial measures would increase the capacity of the I.R.T. by 1.3 times at a cost of $147.50 for each passenger that could be carried over and above the present reasonable capacity of this line. Assuming a total of $815,000,000 as the cost of the Independent (including sections under construction), and the rated capacity used in the Mayor's Committee Rapid Transit Study, the city will have spent $1,132 for each passenger that this system can carry into work centers during the morning rush hours. These estimates of capital costs to the city per passenger carried during the morning rush hours on each line serving the several communities determine rapid transit charges summarized in Table 3(*a*).

Estimates of Annual Expenses

This section of the Appendix outlines the methods used in estimating the annual expenses for operating and maintaining the public services provided in each community.

Except as otherwise noted, unit costs are based upon the most recent information available from the operating agencies. The per capita costs are generally derived from the total annual expense and the estimated population actually living in the city. Therefore, the "actual" population living in the several communities, rather than the "demand" or potential population that would result from 100% occupancy of residential quarters, is used in determining annual expenses that are based on per capita costs. The estimated yearly expenses charged to each community are summarized in Table 3(*b*) by item.

Street Cleaning.—Annual costs of street cleaning average 27.3 cents per sq yd in Manhattan and 13.1 cents in Brooklyn. Snow removal averaged 20.3 cents per sq yd over a five-year period. Computed for the roadway area, there are 157,000 sq yd of roadway to be cleaned in Area A and 142,520 sq yd in each unit. On the basis of full street width there are 263,884 sq yd to be cleaned of snow in Area A and 187,969 sq yd in each unit.

Sewer Maintenance.—The unit cost of cleaning sewers in Manhattan during 1938 was $203.50 per mile and $8.60 per catch basin. Since data were not available for Brooklyn, the unit cost is the same as Queens—namely, $102.50 per mile of sewer and $8.60 per catch basin.

There are 6.76 miles of sewers and 80 basin manholes in Area A, but only 2.92 miles of sewers and 36 basin manholes in Units A_1 and A_2. Because pipe is placed in service roadways, Unit A_3 has 5.52 miles of sewers and there are 36 basin manholes.

Water Mains.—The annual expenses per mile of pipe for water-main maintenance include 70% of the motor vehicle operations cost for mains in existing streets, regardless of pipe size. The age of mains is not considered a factor because unconsolidated fill tends to cause new mains to break more frequently than old pipes. The annual maintenance expense in Area A, and Units A_1 and A_2, is computed at the Manhattan average of $884 per mile of pipe. The cost in Unit A_3 in Brooklyn is based on $449 per mile of pipe per year. Pipe length is given in Table 6.

Street Lighting.—In Area A the annual rental of street lighting equipment from the utility companies is estimated to average $25 per light. In the neighborhood units the city would install and maintain its own equipment. Recent operating experience indicates that the annual expense would be $8.34 per light.

Parks and Playgrounds.—An examination of the Comptroller's Report indicates that appropriations for the operation and maintenance of parks and playgrounds amounted to more than $8,800,000 during 1938. This appropriation represents an average cost of about $525 per acre of park, including all facilities under the jurisdiction of the Park Department. This unit cost is used in estimates of annual expenses in all communities.

Elementary Schools.—The average cost per classroom for physical operation and maintenance of elementary and junior high schools as reported for 1937 is $387 in East Harlem (Area A); but the city average approximates $400 per classroom, which value forms the basis for estimates in all neighborhood units.

The cost of instruction, excluding general administration, averages about $4,000 per classroom for the entire city. Similar data are not available by school district and, therefore, instruction costs for all communities are based on the city average.

High School.—The annual expenses for instruction and high school building maintenance, shown by reports to approximate $159 per student registered, are the basis for the estimates given in Table 3(*b*).

Public Library.—Requests for public libraries submitted in connection with the capital budget indicate that the annual operation and maintenance costs average $35,000 for the type of branch that serves residential districts. With this value as a base, costs are allocated to each community on its "ratio of use" of library facilities.

Health Building.—Each community is charged with its proportionate share of the annual expense of maintaining and operating health center buildings, as given in the Health Department program submitted to the City Planning Commission. The expense in the East Harlem district (Area A, and Units A_1 and A_2) is given as $13,970 per yr, and in the district serving Unit A_3 the total cost is $16,210.

Fire Protection.—Estimates of yearly expenses for fire protection are based on the following per capita charges:

Borough	Dollars per year
Manhattan	4.19
Brooklyn	3.16

These values are derived from reported costs for operation, including equipment, telegraph, buildings, and personnel in the smaller stations, which are assumed typical for residential districts.

Police Protection.—The annual charges for police personnel, motor and other equipment, and building maintenance average $3.22 per person living in Brooklyn and $6.90 per person living north of 80th Street in Manhattan.

Refuse Removal.—The annual maintenance of sanitation garages and section houses, as well as the costs of collecting refuse, are included under "refuse removal" expenses. These expenses average $2.17 per person in Manhattan and $2.02 in Brooklyn. Application of these figures to the population of each community produces the estimates summarized in Table 3(*b*).

Sewage Disposal.—The costs of sewage treatment given for the various plants in the "Tentative Plan for Sewage Disposal" prepared by the Department of Public Works and submitted to the City Planning Commission are used to determine the total operating expenses for each plant. The estimated operating expenses for the Wards Island plant are $650,400 per yr, and for the 26th Ward plant, $213,100 per yr. Each community is charged with its share of the annual expenses in proportion to the "use ratio" of plant capacity.

Refuse Disposal.—The cost per cubic yard of material incinerated is about 20 cents in Manhattan and 18 cents in Brooklyn (see Table 12). The disposal

TABLE 12.—Refuse Disposal Expenses

Area and units	Annual (cu yd)	Incinerated		Land Fill		Dumped	
		%	Cost[a]	%	Cost[a]	%	Cost[a]
A	117,477	44.4	20	4	10	51.6	15
A_1	117,477	57	20	43	10	....	..
A_2	101,373	57	20	43	10	....	..
A_3	101,373	57	18.1	43	6.4	....	..

[a] Cents per cubic yard.

of ashes and other non-combustible material is assumed at about 10 cents per cu yd in Manhattan and approximately 6 cents in Brooklyn. Table 12 shows the total annual collection of refuse in square yards, the disposition by community, and the unit cost (see Table 3(*b*) for the total annual expenses).

Debt Service on Rapid Transit.—This study considers the capital costs of rapid transit a proper charge against communities in proportion to the line capacity used. The annual costs of operation and maintenance of the lines, however, are paid out of operating revenues. Under existing operating conditions these expenses are not met by the city and are not charged against the communities. The city does contribute substantial sums to service its outstanding rapid transit debt. Accordingly, debt service on that part of the subway improvement costs allocated to each community is charged as an annual expense in Table 3(*b*).

The capital cost shown in Table 3(*a*) is assumed to be financed by fifty-year corporate stock requiring annual payments of 4% interest and instalments to a sinking fund earning 3% for amortization of principle.

DISCUSSION

DONALD M. BAKER,[9] M. AM. SOC. C. E.—The problem of rehabilitating residential areas where housing has fallen below the standards for which it was originally developed is one that has attracted considerable attention during the two decades since 1920, and will achieve much greater importance in the future.

During past periods of relatively high rates of population increase in metropolitan areas, land area devoted to residential housing likewise increased comparably. New housing was provided primarily for residents in the high-income and upper middle-class income brackets, whose vacated dwellings were then occupied by those with lesser incomes. With continued growth, these in turn moved on, to be replaced by a succession of residents in progressively lowering economic levels. Ultimately, an area was occupied by those in the lowest income brackets unless, as sometimes happened, such housing was located adjacent to an expanding commercial district. Then commercial or light industrial uses would invade the area, occupying the former residential buildings, or replacing them with newer buildings specifically constructed for particular uses. Until about 1920, little attention was given to the progressive "blighting" of older residential districts. Such phenomena were accepted as a normal result of metropolitan growth. Owners of property in such areas maintained hopes that expansion of commercial or industrial districts would in time reach their property, and give it values based upon such uses.

Community planning, as it is now beginning to be practiced, based upon the scientific method of collecting, analyzing, and interpreting factual data relative to growth and decay, developed a realization that the progressive decay of such areas was an effect, the causes of which were subject to determination, and that in many instances remedial measures were possible. Without question, economic losses due to "blighting" are very great, not only to owners of property within "blighted" areas, but likewise to entire communities where such property exists, and to residents of such communities.

Owners of such property experience not only reduction of value of land, because of lowered rentals upon improvements, but likewise a loss of adequate return upon that part of the improvement—the foundation and the shell of the structure—whose physical life, if it is well arranged and soundly constructed, may range as high as one hundred or more years. Reserves for depreciation and obsolescence are seldom if ever set up in individually owned properties, and are more or less impracticable. Community losses include a reduction of taxable values and loss of a part of the public's investment in improvements and services. These usually have a useful physical life in excess of the life of the area served for any but the lowest type of residential housing or, in time, they develop excess capacity due to population loss in such area.

Loss to individuals includes an increase in taxes to support cost of improvements and services originally provided for the "blighted" area, which fails to

[9] Cons. Engr., Los Angeles, Calif.

carry its share of such cost because of lowered taxable value, and loss to merchants and property owners in business districts serving the "blighted" areas. There is also the expense and loss of time caused to those who, daily or frequently, must travel between outlying residential areas and the central business district a greater distance than they were formerly required to travel.

Movement into new housing is caused by both "pulling" and "pushing" forces. Improvement in financial circumstances, attraction of new surroundings and environment, and more modern conveniences all initiate the movement away from established housing for those who can afford it. A "vacuum," slight in amount, is created, which tends to "pull" into the area residents in lower economic levels who can afford to move up the scale somewhat. Soon environment and neighbors have changed to a point where residents who were not "pulled" out of the area are "pushed" out. The cycle is continuous, and may require many years to change the character of a district from a high to a low level. In general, however, the rate of obsolescence and blighting of a residential district varies directly with the rate of population increase in the community as a whole.

With a reasonably high percentage rate of population increase, the supply of persons required to fill up the vacuum created by the outward flow of residents from older districts usually exists all through the scale. The 1940 federal census brought home to many people, however, the fact that most metropolitan areas, as well as the nation as a whole, are fast approaching a static condition in regard to population, and that former rates of increase will not be maintained.

This condition will undoubtedly bring the problem of the "blighted" area into a far clearer focus. Unless American society becomes far more static than it has in the past, with barriers between those in various economic strata becoming far more inflexible, there will always be a large segment of the population who will yearn for, and also be able to achieve, better housing, surroundings and environment, modern conveniences, and everything else that goes with improved circumstances. The demand for new housing will continue; and the "blighted" areas will increase also, but the supply of residents for these latter areas will not be forthcoming as it has in the past, and decay and loss of values therein will be accelerated.

New housing, as now produced, is usually supplied around the periphery of present developed areas. It entails the expense of the many facilities indicated by the author. These expenses are usually a community obligation. Arresting decentralization of population through rehabilitation of areas now in this condition, or approaching it, means large annual savings in dollars and cents to the community, and therefore to its taxpayers.

There is another side of this problem of rehabilitation, however, which pertains to the owner of property in a "blighted" area, who might desire to undertake rehabilitation, or to the investor who might desire to finance it. In many instances, rise in price levels over a long period, and likewise rise in values due to general increase in population of most communities, have reduced

losses due to depreciation or obsolescence when property has changed hands. The temptation to spend all revenues received from rentals, except that immediately necessary for routine expenses, maintenance, taxes, interest, and amortization of loans, is increased by the feeling of rising valuations offsetting, at least to a degree, depreciation and obsolescence.

An owner, or an agency contemplating development of new housing to replace old existing housing in a blighted area, is faced with the following problems:

(1) A large area must be acquired if a proper environment is to be created, such area ranging from at least 40 acres to possibly several times this extent. Demolition of a few existing structures, and their replacement by new and modern buildings, will not create environment.

(2) To secure control of an adequate area, many individual properties must be assembled and purchased, or condemned, entailing large outlay of capital for land alone.

(3) When the cost of buildings is added to the capital investment required for land alone (which in a project of this nature would include land and obsolete improvements), any such project takes on very large proportions.

(4) When such investments are constructed upon unimproved land in peripheral localities, the owner's investment usually includes the cost of an unimproved site, of buildings, a certain amount of landscaping, and those public improvements and services not usually provided by the community or existing public utilities. It is questionable in many cases if the increased rentals received from new developments in a rehabilitated area will support the added site cost in such an area.

For years sociologists have stressed the economic losses resulting from substandard housing—losses resulting from sickness, from crime developed in such housing, and from increased costs of fire and police protection. These losses have even been evaluated in terms of dollars and cents. So far, research has failed to develop a type of low-cost housing within the reach of those in the lowest economic circumstances, without some form of subsidization. The propriety of public subsidization of housing for this part of the population has recently been accepted, and many low-cost housing projects have been constructed or are contemplated.

With the definite community savings as shown by the author, which are affected by rehabilitation of "blighted" housing through site planning, and construction in accordance with new and modern standards, the writer poses this question: "Would it not be a sound investment if such projects likewise were to receive public subsidization from the community, at least to an extent which allowed the increased burden of added site cost to be overcome?"

The paper is a distinct contribution to the literature of this subject, made in a language that businessmen understand—that of dollars and cents.

Howard Whipple Green,[10] M. Am. Soc. C. E.—With the United States approaching a stable population and its large cities beginning to realize that

[10] Secy., Cleveland Health Council; Director, Real Property Inventory of Met. Cleveland, Cleveland, Ohio.

their population increases will be much more moderate in future decades, with several large cities for the first time showing actual decreases in population while their suburbs still continued to increase, with fewer and fewer persons left in the central city to bear larger and larger tax burdens, with industry and commerce showing indications of decentralization, and with slum and blighted areas increasing in extent and severity, the problem of rebuilding cities in the United States ranks near the top of the list of important things to be given attention following the present national emergency.

A possible solution to this serious problem of the depopulation of the center of most large American cities with increases in population around the periphery is indicated by the detailed calculations presented in this paper. Although all computations presented are naturally based upon New York City, standards of land use, and unit costs of public improvements and services, similar computations made in smaller cities with different standards of land use and different unit costs may demonstrate even more striking differences between the rehabilitation of existing blighted areas, the entire rebuilding of these areas, and the relocation of their populations on vacant land in outlying sections within or beyond their corporation limits.

The basic facts made available in Cleveland, Ohio, by the continuous Real Property Inventory started in October, 1932, augmented by unit costs of public improvements and services, make such a study possible with a minimum amount of effort.

Cleveland being built horizontally, contrasted with New York's vertical pattern (especially the Borough of Manhattan), doubtless will show quite different factors. However, it is as true in Cleveland as in New York that the public utilities that were complete in the section designated as census tract J-1 (with a population of 6,114 in 1910), which decreased to 493 in 1920, to 49 in 1930, and to 3 in 1940, were of no assistance to census tract T-8 with a population of 59 in 1910, which increased to 1,557 in 1920 and to 10,577 in 1930, decreasing to 9,986 in 1940; nor were the schools, hospitals, and churches, or the retail stores, water mains, sewers, paving, gas lines, and electric and telephone networks serving the 6,114 inhabitants of census tract J-1 in 1910 and quite useless to the 3 persons living in this area in 1940 of any aid to the suburb of University Heights, which increased from a population of 156 in 1910 to 5,981 in 1940. Such a shifting of population is one problem during periods of rapid population expansion accompanied by proportional expansions of industry and commerce, but it is quite another as a stable population is approached.

T. T. McCrosky,[11] M. Am. Soc. C. E.—Many large-scale real-estate developers have made detailed cost studies of the relative economics of private building operations on high-priced improved slum land versus low-priced raw land; but their studies do not include consideration of the costs to the public that enter into their contemplated developments. To the writer's knowledge, Mr. McHugh's paper is the pioneer research in the field of cost of public services made necessary by large private residential projects. As a former colleague

[11] Executive Director, Chicago Plan Comm., Chicago, Ill.; formerly Director of Planning, Dept. of City Planning, New York, N. Y.

of the author, it was the writer's privilege to follow this study closely during the months that it was being conducted without, however, participating directly in its progress.

Similarly thorough analyses could be made for other cities, with different unit costs and appropriate modifications in the assumptions; but the resulting quantitative comparisons would assuredly be of the same general order of magnitude, differing only in degree. The case is proved by this study. It costs the public very much more to provide services for outlying developments than for equivalent redevelopment projects in "near-in" locations, where many satisfactory public facilities already exist. Whether it be 50% to 90% more per person housed, as computed by the writer (for Units A_1 and A_2, where rapid transit charges are excluded), or some moderately lesser or greater figure, is of secondary importance to the fundamental conclusion that it is manifestly uneconomical from the public standpoint to encourage the decentralization of cities.

The great difference in public costs between development of areas with existing transit facilities and areas where new transit lines must be provided is clearly revealed by the author. The moral is inescapable that the least a city should do is to discourage new large-scale building on outlying vacant land that does not have, but will require, transit service.

It would be very valuable to have an extension of this study, in order to develop consolidated comparisons of capital and operating figures for the combination of public services plus private project costs. The differentials of public outlay are both capital and current account. They result from the cost of duplicating facilities and services already existing at the central location. These have been very thoroughly and ably analyzed by the author. The principal differentials of private outlay are capital items. They are the price of land, the expense of assembling it, the cost of the improvements, and the cost of the demolition of slum buildings to make way for the new project. Unfortunately, slum buildings do not tumble down like the walls of Jericho at the summons of a Joshua.

With a consolidated cost comparison, it would then be fruitful to study the feasibility of offering some partial public subsidy to the private builder to encourage him to redevelop slum areas. This could be scaled so that the costs to the taxpaying public, including subsidy, still would be well below what they would aggregate if the builder developed outlying raw acreage. In practice, the subsidy might often take the form of giving title deeds to tax-foreclosed properties, which were foreclosed because they yielded no taxes and thus made no return to the public, and which can never make a return unless transferred to a private owner for sound redevelopment. Another form of subsidy that costs the public nothing is to deed unnecessary street land to building corporations. Partial or limited tax exemption is also "cheap at the price," inasmuch as slum land is notoriously delinquent in most cities. If the public actually collects moderately more taxes from the new project than it did from the substandard properties that are replaced, it is "ahead of the game."

When peace comes, urban America will need a coordinated program for city rebuilding, embracing all price and rental brackets and clearly determining the

extent and limits of public and private participation in each bracket. Preparation of this program is the responsibility of the technical professions in the building field. Mr. McHugh's paper is a valuable contribution to the economics of this broad-scale approach to urban redevelopment.

F. Dodd McHugh,[12] Esq.—There have been vast changes in the world since the paper on "Cost of Public Services in Residential Areas" was first published. The United States is at war, and the Nation has passed from a defensive phase of preparing for some vague eventuality into a period of vigorous war activity. Its main efforts are directed toward winning a most difficult war to secure freedom. Many individuals are engaged directly or indirectly in the war effort or in civilian defense activities.

Under the circumstances, it may seem like "fiddling while Rome burns" to discuss such matters as public outlays for municipal services. Upon many recent occasions it has been said, however, that one must not only win the war but the peace. To win the peace the people must define their goals and do an extraordinary amount of enlightened planning while the war is being fought.

When the phenomenal efforts of the United States and its Allies have brought peace to the world, most of the old problems will remain and a host of new ones will have appeared. What will the Nation do about some of the now familiar domestic problems? Plans are already in the making for the readjustment of private business after the war, for public works programs, and, among other things, for urban redevelopment. It would seem the logical time to discuss public outlays for municipal services, if such investigations can aid in the clarification of policy and in the formation of postwar action programs.

Planning for the Postwar Era.—There is already wide recognition of the necessity for careful planning for the postwar period, and many public and private agencies are doing research in a variety of fields.[13] The executive branch of the federal government has stated broad objectives and initiated investigations and long-range programs directed toward meeting the future social and economic needs of the Nation. In transmitting to the Congress the "Development of National Resources—Report for 1942," prepared by the National Resources Planning Board, the President stated in part,

> "Plans and programs to win the war and to win the peace must grow out of our common national purpose and with democratic participation in planning by all of us. Through efforts to state our objectives and public discussion of their merits, we play our parts as free citizens."

This report suggests for discussion the following principal objectives of postwar planning: Full employment and maintenance of the national income at not less than $100,000,000,000 a year, without lowering working standards; decentralization of postwar activities and full use of free enterprise in cooperation with national and government leadership; and individual realization of security,

[12] Director of Planning, Dept. of City Planning, New York, N. Y.

[13] See the survey on "Post-War Planning in the United States," by George B. Galloway, The Twentieth Century Fund, New York, N. Y., 1942.

opportunity, and the basic freedoms. It also suggests upbuilding America as the keynote of a postwar program,

> "* * * including both development of our national resources adding to the National Estate, and service activities, which will increase the vitality, health, skill, productivity, knowledge, and happiness of the American people, and thus together end unemployment and add to our wealth and well-being."

This is not the place to enlarge upon these objectives, but an outline of them indicates the breadth of thinking in the federal approach to winning the peace on the domestic scale. The National Resources Planning Board is correlating plans and programs under consideration in many federal, state, and private organizations for postwar full employment, security, and building America. Among other things, it not only furnishes aid in various phases of the war effort, but it also brings together 6-yr programs of federal agencies and aids in developing programs of useful public improvements and services planned by state and local governments. With the necessary detailed plans completed, this great reservoir of public works can help to absorb the men and industry that will be demobilized after the war.

The New York City Planning Commission is proposing that the 1942 Capital Budget be amended to provide funds for the planning of a postwar program of public works. Some funds for general planning studies, sites, preliminary plans, working drawings, and specifications are provided in the 1942 Budget. The proposed Post-War Works Program would expand the reserve of projects that can be undertaken, whenever men, materials, and funds are available, by completing plans for a considerably enlarged number of desirable municipal improvements.

Regardless of the as yet uncrystallized results of current discussion and planning for postwar activity, one can readily agree that any action programs that may be developed cannot do less than promote the conservation of human and natural resources in a society of free men. It is perhaps a poor commentary, but human society seems able to achieve its greatest organization and productivity in periods of national and international stress. In the intervening peaceful times, the extraordinary cooperation attained in emergencies fades. There is no actual reason, however, why a democratic system cannot function equally as well for peace if it can agree upon broad objectives and mobilize the creative, organizing, and productive abilities of its people to promote the general welfare.

In the discussion, planning, and execution of any postwar program, the individual as well as the system of private enterprise must make substantial contributions. Government may have to give new forms of assistance and some direction in coordinating private action with public programs, but enlightened free enterprise must play a major part in attaining anything like full employment, security, and the upbuilding of America in the postwar era.

Urban Rebuilding.—There will be many possibilities for new cooperative activities after the war, including urban redevelopment. More than one half

the population of the United States lives in urban areas, and about 48% of it in some 140 metropolitan districts. The 1940 census data clearly reveal that the rate of population growth in the United States is slowing down to the point where it will probably approach stabilization during the life of the present generation. Urban and metropolitan areas are following this general trend, with a few notable exceptions. Consequently, there is a definite need for ordering the towns and cities of the Nation on a more up-to-date and efficient basis for working and living if they are to serve their functions properly in an era of population stability. The social and economic losses due to overexpansion, blight, and obsolescence must be arrested. Existing transportation facilities should be improved and integrated with the transportation advances that undoubtedly will follow the war; obsolete housing should be replaced by large-scale residential neighborhoods designed to improve living conditions and to stabilize the residential character of communities on a high social level.

These notions are not new; they are being discussed throughout the Nation. The importance of coordinating public and private plans and actions in urban rebuilding is obvious. Similar cooperative efforts are already under way in England. Such a program requires the definition of national and local objectives, and the development of new approaches and techniques to draw the broad outlines and fix the tempo within which the gigantic task of city rebuilding might proceed.

Public Costs and Other Factors.—The "Cost of Public Services in Residential Areas" is one of many kinds of investigations needed, and in fact it was undertaken as part of a larger scheme of approach to municipal problems in New York City. As mentioned in the discussions, these urban problems are much greater than the relative costs of public facilities in certain types of residential development.

Mr. Baker has noted the economic losses of individuals, property owners, and the public at large due to urban blight and decentralization. Incidentally, one phase of the original cost study indicated that overexpansion and duplication of public services in residential areas are costing the City of New York at least $40,000,000 annually for operation and maintenance. This is a rough estimate, to be sure, but it suggests the extent of economic loss suffered by the public as a result of blight and decentralization within the city's boundaries. Mr. Baker also mentioned the problems of land assembly and high site cost in connection with large-scale rebuilding. He asks if rents in a rebuilt area can support the high site cost and suggests that it might be a sound investment to subsidize such residential projects, at least to the extent of overcoming the burden of high land acquisition costs. Here is one of the greatest obstacles to city rebuilding. It would appear questionable that even one community could be rebuilt privately on a large scale and become self-supporting without public financial assistance because the rentals that its tenants could afford are almost certain to be insufficient to cover the high site cost plus the expense of new dwelling construction. The ease of land assemblage and its relatively low cost in suburban and outlying urban areas permit profitable private developments,

and account in some measure for the continued physical expansion of cities even after population growth is drastically reduced.

Mr. Green ranks rebuilding problems near the top of the list of important things to be given attention following the present national emergency. The writer agrees with the ranking and with the absolute need for concentration on the war effort, but he is convinced that means must be devised and plans developed for urban rebuilding before the war is over. Otherwise, the Nation will be in a less favorable position in winning the peace. Had Mr. Green presented such computations of public costs in Cleveland, they would have been a welcome addition to the paper. Its continuing Real Property Inventory puts Cleveland in the enviable position of knowing of current changes, and the data thereby available make such investigations as a cost study relatively easy.

Mr. McCrosky suggests that the cost study should be extended so as "to develop consolidated comparisons of capital and operating figures for the combination of public services plus private project costs." He also mentions the problems of site acquisition and suggests an investigation of the feasibility of offering some kind of partial public subsidy to the private builder as encouragement in the redevelopment of slum areas. He makes an excellent point in stating that, since tax delinquency is prevalent in slum areas, limited tax exemption would be justified if the actual tax yield on rebuilt projects exceeded the taxes collected from the replaced substandard properties.

In the section of the city represented by old Area A of the cost study, it was found in 1938 that some 23% of the properties were tax delinquent. On the basis of this delinquency ratio and a basic levy of 2.75 on an assessed value of 29.8 million dollars for residential property in old Area A, the city collected about $630,000 in taxes from housing in this area. Assuming for the moment that new housing in rebuilt Unit A_2 is assessed at the same value as the existing residential properties (29.8 million) and the tax levy remains at 2.75, collections should average 98% of levy. On this basis the tax yield would approximate $820,000 per yr, which amount is 1.29 times current collections in old Area A.

The total costs of land and new housing in rebuilt Unit A_2 may be expected to exceed the present assessed value of existing dwellings in old Area A by an amount which would be determined by site and construction costs. However, if the assessed value of new housing in Unit A_2 were held at the same level as existing dwellings in old Area A, the private developer thus would receive a form of public subsidy; but the city's debt incurring and taxing powers would not be curtailed by a reduction in assessed value and, as Mr. McCrosky states, the city would be "ahead of the game," in so far as taxes collected on the new housing exceeded the present yield of taxes levied.

The discussions have been most profitable. The writer was disappointed, however, that the assumptions and techniques of the cost study were not subjected to a more critical evaluation. The setting given to the study and the questions raised in the discussions lead to further comment on investigations undertaken since completion of the original cost study in 1939. In this con-

nection it should be made clear that the material contained in this closing discussion, as well as in the paper, does not in any respect represent the opinion nor the policy of the New York City Planning Commission or of the Department of City Planning.

Current Studies.—There is considerable evidence of a widespread approach to the solution of urban problems. The following is by no means a complete summary, but it is illustrative of current trends. In its "Urban Progressive Planning Project" the National Resources Planning Board is attempting to establish procedures for the progressive planning of required urban facilities. The Federal Housing Administration (FHA) has prepared *A Handbook on Urban Redevelopment for Cities in the United States.* It contains timely suggestions for procedures in an integrated long-term program for dealing with slums and blighted urban areas. The Illinois and New York State legislatures have enacted urban redevelopment laws that attempt to attract private capital into the rehabilitation of cities.

The findings of the cost study indicate that large-scale rehabilitation of old central apartment districts is economically feasible and preferable to new developments in outlying sections in so far as city expenditures are concerned. The paper concluded with a suggestion that essential studies of the private costs involved, and of the procedures to be used in large-scale redevelopment of entire neighborhoods, be undertaken immediately under a joint private and public sponsorship. The study showed that, if all the persons living in old Area A were rehoused on the same site, the new dwellings in Unit A_1, at an average height of six stories, would cover 68% of the residential land and the net density would be 731 persons. In setting up Unit A_2, it was assumed that apartments averaging six stories and covering 50% of the residential land, with a net density of 540 persons, would produce a better living arrangement and that thus Unit A_2 would be subject to a much lower rate of obsolescence than Unit A_1. The costs per person housed were also found to be lower in Unit A_2 than in Unit A_1. This finding suggests that there may be an optimum density, at which public costs per capita would reach a low point, in the rebuilding of old Area A.

A study was made to ascertain this population density or range of densities. Regardless of other considerations, it was assumed that old Area A might be rebuilt to house a varying number of people, and the calculations were based on the same suppositions and technique used in the original study. (The computations were made under the author's direction by Roger W. Loewi, "Interne" in the Department of City Planning during the summer of 1940.) A part of the results are given in Table 13, which shows that the lowest per capita city expenditures are attained in rebuilding old Area A at a density of 324 persons per residential acre. This particular 160-acre community, identified as Unit C in Table 13, could house more than 24,500 people in buildings covering 30% of the residential land at an average height of six stories. The per capita cost varies within narrow limits, however, as between the communities designated as Units B, C, and D. Although not shown in Table 13, it was found that per capita costs for developments with densities greater than

731, and less than 108 persons per residential acre, increase at a more rapid rate than the change in density. This indicates that, other things being equal, it would be better from the point of view of public outlays required to rebuild old Area *A* as a modern community within a density range of about 250 to 430 persons per residential acre. This possibility raises an entire series of questions concerning the community's place in the scheme of things, such as the desirable urban pattern for the entire city and its parts, as well as the objectives, techniques, and standards for planning the redevelopment of American cities—in this case the residential sections of Manhattan in New York City.

TABLE 13.—CITY EXPENDITURES PER PERSON, BASED ON APARTMENTS AVERAGING SIX STORIES IN HEIGHT
(With Transit Charges)

Rebuilt community	Proportion of land covered (%)	Persons per residential acre	Improvement (dollars per person)
Unit A_1	68	731	163
Unit A_2	50	540	119
Unit *B*	40	432	96
Unit *C*	30	324	95
Unit *D*	20	216	98
Unit *E*	10	108	110

Private Costs in Rebuilding.—Mr McCrosky's suggestion that the cost study be extended to develop consolidated comparisons of capital and operating figures for the combination of public services plus private project costs is difficult to carry out, due to a multiplicity of variable factors. Several attempts, made along these lines, have so far failed to produce satisfactory results. Complex problems are involved and available data are insufficient. One angle of approach might be somewhat as follows:

The people now living in the specimen community, old Area *A*, have different incomes—not all of them are in the lower income category. In rebuilding such obsolete sections on a large scale, it will be necessary to make provision for families of varying income. Assume that in the present case the engineer is concerned with an average community that will accommodate all groups. With this assumption it is possible to deal with the average rental that people can afford to pay. In New York City this sum is approximately $520 annually per family, which represents the average "demand." What can the private developer supply to meet this demand?

The answer to this question is conditioned in large measure by the capital outlay required of the private developer and the annual carrying charges on the completed project. For purposes of discussion, assume that the operation and maintenance, including insurance and a vacancy allowance, can be held to an average of $150 per dwelling unit. On the basis of the $520 average annual income received for each dwelling unit, and an annual cost of $150 for operation, etc., the private developer would have $370 left to cover taxes, capital charges, and interest on his equity.

Since the problem concerns a large-scale development that offers unusual stability of investment, it is possible that the private developer can obtain capital at 4% and, because the investor will want his capital repaid, the loan might be amortized at, say, 1.5% annually. With annual interest payments fixed at 4% and amortization at 1.5%, the borrower would repay the entire

loan in about thirty-four years. This setup is similar to recent financing under the FHA mortgage insurance plan.

The private developer also must receive a return on his equity or investment. In these days of low capital earning, one may assume a 6% return to be quite attractive. Inasmuch as the rebuilt community is a large-scale affair, requiring adequate public facilities on modern standards, the city could not afford to supply improvements and services without making some charge for them. Therefore, real estate taxes should be included in considering private costs. These private costs may be expressed as:

Item	Percentage of total capital cost		
Interest	4%	on 80%,	or 3.2%
Amortization	1.5%	on 80%,	or 1.2%
Equity earning	6.0%	on 20%,	or 1.2%
Taxes	2.75%	on 92%,	or 2.53%
Total			8.13%

The private developer receives on the average only $370 per dwelling unit to cover these changes. This amount capitalized at 8.13% is $4,550, which represents the total private investment per dwelling unit that can be made economically in this particular case. In a large-scale operation it may be possible to effect such economies that existing structures on the site could be demolished and the new dwellings erected at an average cost of $3,640 per family unit. For this "average" case this development cost is roughly 40¢ per cu ft. At such a favorable rate for construction costs the private developer could afford to pay $910 per dwelling unit for land. If the community is built to house 250 persons per residential acre, land could not cost more than $1.42 per sq ft; at a density of 430 persons per residential acre, the developer could pay $2.45 per sq ft for land. At a density of 540 (provided in rebuilt Unit A_2 of the cost study), the economic value of land is slightly more than $3 per sq ft under these assumptions.

There is not much land in urban slum districts that can be purchased at these figures. At rentals below the afore-stated $520 average, the situation is obviously more difficult, and, inversely, building for rentals greater than $520 is relatively easier. (This average rental does not include rents from stores, parking garages that could be located in the basements of residential structures, nor other miscellaneous income.) Of course, a higher average income might permit higher rents and greater land values, but the resulting increase in living standards could not be counted upon to reduce building costs.

Public and Private Costs.—The sums used in this illustration of an average condition may or may not be valid in so far as the exact private costs of development are concerned. One of the objectives in urban redevelopment is to rehouse people at rents they can afford to pay. With an average rental income of $520 per yr, the private developer can spend only $4,550 per dwelling unit, or approximately $1,240 per person, under the conditions assumed. If the capital charges and operating expenses are larger than those assumed, the

total private capital cost would be reduced. The point the writer wishes to make, however, is that, whatever the exact figure, private costs per dwelling unit or per person, based on a given rental income, remain at the same average amount regardless of any change in population density. On the other hand, the cost study shows that public improvement costs per person vary with the density of population. Consequently, a combination of public and private capital costs does not appear to throw as much light on the problem as Mr. McCrosky anticipated.

Mr. Baker emphasizes these economic difficulties in his discussion and asks if it would not be a sound investment to subsidize such residential projects, at least to the extent of overcoming the burden of high land acquisition costs. If it were possible to exempt the project from real estate taxes, the situation could be eased. On the basis of the foregoing illustration, the private developer could spend a total of $6,600 per dwelling unit if he did not have to pay taxes ($370 capitalized at 5.6%). Allowing the same figure for construction ($3,640 per dwelling unit), he could afford to pay about $3 per sq ft for land at a density of 250 persons per residential acre; about $5.25 per sq ft for land at a density of 430 persons per residential acre; and about $6.60 per sq ft for land at a density of 540 persons per residential acre.

What Are the Possibilities?—Large-scale tax exemption would make it nearly impossible for most cities to remain solvent under current means of raising municipal revenue. Apparently, engineers must look elsewhere for a solution. It may be possible to devise ways of reducing private operating and maintenance expenses, and to cut building costs with mass construction methods; or the cost of capital may also be cut in proportion to the elimination of risk in investment. If all of these economies could be made, the high cost of land would still remain an obstacle to urban rebuilding.

Limited tax exemption would be helpful, but it is well known that revenue received from taxes levied on residential property does not cover the actual cost of public services provided in residential sections. For example, total annual expenses for public services in old Area A are estimated at more than $1,600,000 and the tax yield at some $630,000 per yr. If partial exemption, on the basis heretofore mentioned, were granted to the rebuilt Unit A_2, a tax yield of about $820,000 could be expected; but annual expenses for public services would exceed $1,300,000 per yr. Thus, the city would forego a higher tax return, not for the purpose of reducing rents nor to give greater service for the same rents, but to underwrite site costs that are greater than the actual and potential use value of the land.

Perhaps the creation of public land corporations or authorities, with the power of eminent domain and of issuing bonds secured by the land, should be considered. If the land and improvements were subject to real estate taxes, the city's taxing and debt incurring power would not be impaired. This is not an original suggestion (see the FHA *Handbook on Urban Redevelopment for Cities in the United States*). With this type of public ownership, the land could be leased for appropriate private development, and the purchase price of the land could be amortized over a sufficiently long period so that the ground

rent charged the private developer would coincide with the economic use value of the land.

Even if land "costs" can be reduced in this manner, the engineer must still find the means to effect economies in construction costs and operating expenses, as well as in charges for the use of capital. Otherwise, large-scale urban redevelopment cannot be attained at economic rental levels. If these or similar devices can be developed and put into operation in the near future, engineers can also perfect their procedures and techniques, and commence the planning and timing of urban redevelopment as an integrated part of postwar activity.